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DEAR READER

Translated from Metallurg, No.12,
p. 1, 1960

1960, the second year of the Seven-year Plan is drawing to its close. Less than two years have elapsed since the program for the developed structure of the material and technical basis of the communist society was approved by the 21st Congress of the Communist Party of the Soviet Union, and what enormous progress has been achieved in this short time in all branches of the national economy Industry, transport and agriculture are developing at a high rate. The measures outlined at the 21st Congress of the Party for raising the material well-being and cultural level of the workers are being successfully carried out.

Soviet metallurgists are making an enormous contribution to the successful accomplishment of the Seven-year Plan They have won the esteem and love of the entire Soviet nation by their renowned work.

Still greater problems confront the metallurgists in the new year of 1961. There is no doubt that under the guidance of the Communist Party, these problems will be solved just as successfully as in the first two years of the Seven-year Plan. The guarantee for this is the creative enthusiasm of the army of many thousands of metallurgists and their aspiration to take the decisive step on the road to communism.

We hope that in the coming year, you, dear readers, will take an active part in the work of the journal "Metallurg." Send us articles and notes on the work of your shops and departments, and on the success of the rationalizers and inventors, teams and shock workers of Communist labor.

Comrades Metallurgists, we wish you a Happy New Year. We wish you fresh, increased successes in your productive capacity and happiness in your personal lives.

AUTOMATIC REGULATION OF THE SPEED OF A SINTERING MACHINE

I. P. Khudorozhkov, Yu. V. Simakov,

G. S. Nesterov and S. V. Bazilevich

Nizhne-Tagil Metallurgical Combine and Ural Scientific Research Institute for the Mechanical Concentration of Minerals

Translated from Metallurg, No.12, pp. 2-4, 1960

In recent years several systems have been developed for the automatic regulation of the speed of sintering machines in accordance with the sintering process. The moment of approach of the combustion zone to the grate, which defines the termination of the sintering process, was determined from the temperature of the waste gases in the last suction boxes or the temperature of the sinter cake and its electrical conductivity. The principal drawback of these methods is that the signal is produced only at the end of the process.

In the course of several years, attempts have been made at the Vysokogorsk sintering plant to regulate the speed of the sintering machine automatically from the difference in temperature between the last and the penultimate suction chambers.

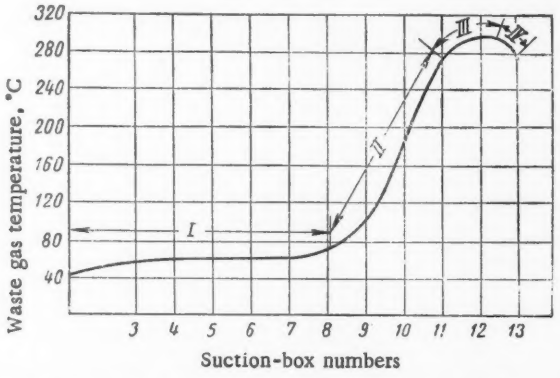

Fig. 1. Curve of variation in temperature of the waste gases along the length of a sintering machine. I) Constant temperature section; II) ascending portion of the curve; III) region of maximum temperatures; IV) descending portion of the curve.

During the adjustment of the system, this pulse was found to be completely unsuitable for automatic regulation. The temperature in the last chamber is distorted by considerable leakage, and the pulse $t_{13} - t_{12}$ is late, and if the charge is not constant, is not characteristic of the sintering operation.

Relationship between the Value of $t_{11} - t_9$ and the Degree of Sintering of the Charge

Degree of sintering of the charge	Frequency distribution of the values of $t_{11}-t_9$, %								Mean value of $t_{11}-t_9$, °C
	15	15—30	30—42	42—60	60—78	78—96	96—132	132—156	
Undersintered	7,9	38,9	36,8	16,4	—	—	—	—	33
Standard	—	10,3	13,8	51,7	24,2	—	—	—	60
Oversintered . . .	—	—	—	4,5	9,0	31,3	40,9	14,3	101

The variation in temperature of the waste gases and the suction over the entire length of the sintering machine were considered, together with a visual estimate of the breaking up of the cake as it left the machine. The degree of sintering was arbitrarily defined as the depth of the zone of unsintered charge expressed as a percentage of the total depth of the bed.

The temperature curve of the waste gases over the length of the sintering machine can be conditionally divided into four portions (Fig. 1). An analysis of more than 500 curves showed that the completion of sintering is characterized most clearly by the difference in temperature in portion II, corresponding to suction boxes Nos. 9 to 11 along the length of the sintering machine. The temperature difference $t_{11} - t_9$, referred to the corresponding interval of time (temperature gradient in respect of time), characterizes the mean vertical sintering rate in the lower half of the cake and depends exclusively on the properties of the given charge.

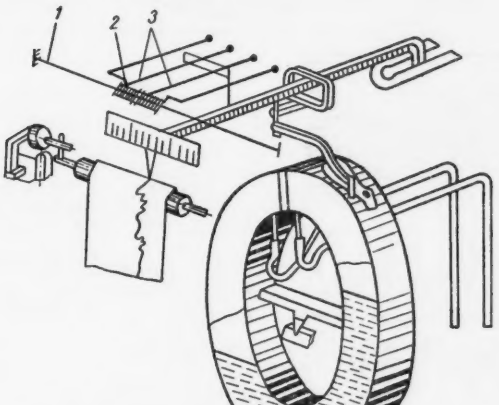

Fig. 2. Diagram of draft gauge fitted with rheostats: 1) Steel cable; 2) carriage with resistances; 3) sliders.

The characteristics of the process can all be referred not only to time, but also to the length of the machine. The temperature difference $t_{11} - t_9$, referred to the length of the corresponding portion of the machine (temperature gradient in respect of length), is determined by the properties of the charge and the speed of the machine. Both gradients are connected together by the value of the speed of the sintering machine.

Practical measurements showed that the charge is sintered normally for a mean temperature difference between the 9th and 11th suction boxes of 60°C (see table).

The investigations made also confirmed the unsuitability of using the temperature difference between the 12th and 13th suction boxes as pulse for regulating the speed of the sintering machine. Analysis of the curves obtained showed that in the absence of any considerable amount of leakage, regulation according to the difference $t_{13} - t_{12}$ does not guarantee against oversintering, and in the presence of leakage, it does not guarantee against undersintering.

In addition a study was made of the properties of another technical parameter, i. e., the suction below the grate. It was found that in some boxes, these values do not differ greatly either from one another or from the suction in the common waste gas pipe. Subsequently, therefore, only the variation in the total suction in the gas main was considered.

It is obvious that this value depends on the initial gas-permeability of the charge, the degree of finality of the sintering process of the entire cake and also the power of the exhauster and the magnitude of detrimental leakage. If the last two factors are considered to be constant, then there should correspond to a definite charge a mean value of suction during the entire sintering period.

In actual production conditions, however, the value of the detrimental leakage cannot be regarded as constant, and therefore the value of the vacuum cannot be used for regulation "from a given" value. Meanwhile, the direction of the variation in the suction value distinctly characterizes the variation in the course of the sintering process. The system for the automatic regulation of the speed of a sintering machine, as adopted for test and subsequent industrial application, was based on two pulses: the difference in temperature in the 11th and 9th suction boxes, and the suction in the common waste gas pipe.

The system was put into practice constructionally as follows.* A draft gauge of the "ring balance" type was fitted with a moving carriage comprising two resistances in the form of small rheostats (Fig. 2), connected respectively to the two arms of the double bridge of proportional controller IR-130.

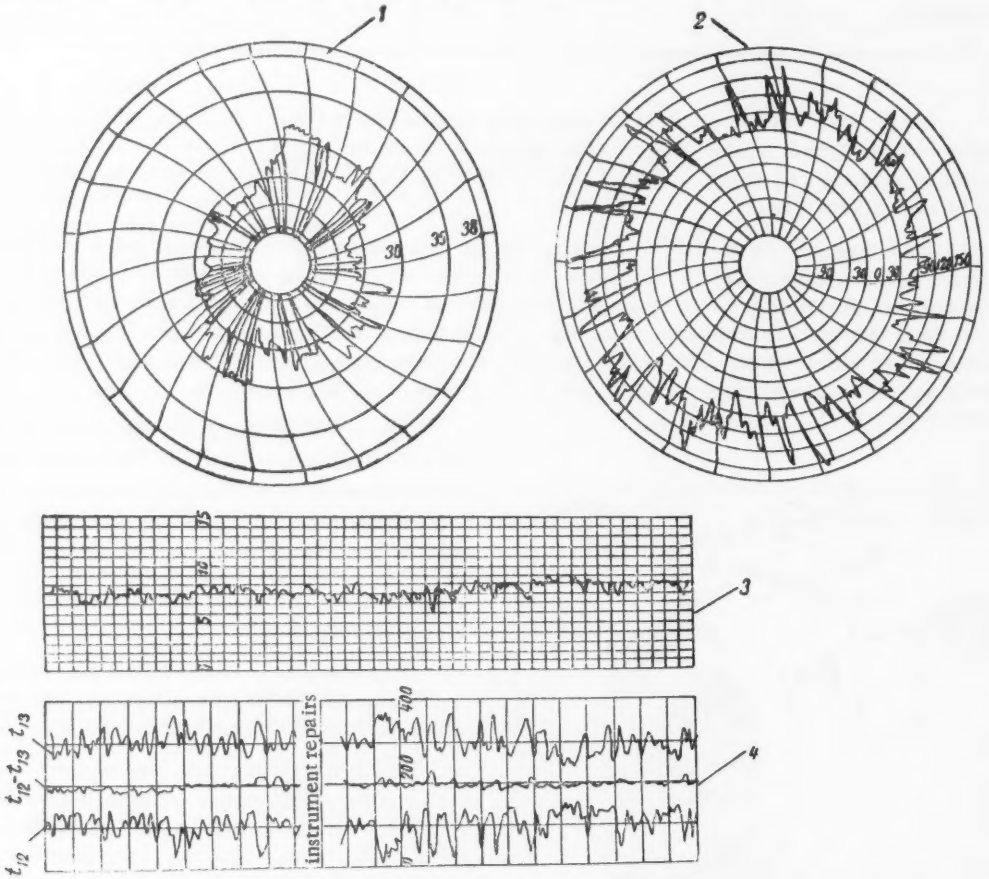

Fig. 3. Charts showing working of sintering machine No. 4 on automatic control: 1) Speed chart, m/min; 2) chart of $t_{11} - t_9$, °C; 3) suction chart, mm water gauge; 4) chart of $t_{13} - t_{12}$; t_{13}; t_{12}, °C.

The value of the resistance is selected on the basis of a variation in suction of 250 mm water gauge. If it varies by a larger amount, the carriage is moved to a new position and thus a new mean value of suction is established. The thermocouples are connected in "opposition" to the bridge of an electronic potentiometer. The two pulses are added algebraically by the proportional controller, and the total signal is passed to the final control element. In the event of matched variation in suction and temperature difference, the pulse is strengthened, and in the event of mismatched variation, the pulse is weakened.

The system described is operating successfully on the sintering machines of the Vysokogorsk sintering plant. Charts illustrating the working of one of them are reproduced in Fig. 3, where for comparison a record is

*V. A. Busygin assisted in the construction.

given of the temperature difference in the 12th and 13th suction boxes. As will be seen from the chart, this difference varies but little and has practically no influence on the sintering process.

EXPERIMENTAL OPERATION OF A LARGE VOLUME BLAST FURNACE

M.Ya. Ostroukhov, V. I. Kholsokov, and Yu. A. Popov

Chelyabinsk Metallurgical Works and "NIIM"
Translated from Metallurg, No.12,
pp.4-9, 1960

In October 1958 a large blast furnace was brought into production at the Chelyabinsk Metallurgical Works.

The composition of the ore fraction of the charge was very inconsistent. During the first few months the ore charge consisted of 5-7 components among which were: sinter from two plants (Bakal and Chelyabinsk) and limonite, magnetic ore, and siderite. The average chemical composition of these materials for 1959 is shown in Table 1.

Throughout 1959 the slag basicity at the Chelyabinsk Works was systemically raised; at the end of the year it was at a level of 1.1-1.2. Metallic additions were not used at all.

TABLE 1

Analyses of Sinter, Ore and Limestone during 1959

	Fe	SiO_2	FeO	Fe_2O_3	Al_2O_3	CaO	MnO	MgO	P_2O_5	losses	S
Bakal Plant Sinter	45,67	15,56	18,03	45,47	6,04	8,32	1,86	2,53	0,106	1,32	0,053
Ch.M.Z. Sinter	48,54	18,50	17,95	49,79	3,81	13,42	0,90	1,42	0,179	0,728	0,085
Siderite	33,43	6,73	27,84	14,68	1,68	3,86	1,41	9,07	0,054	32,40	0,265
Bakal Sorted Ore	48,11	11,80	0,65	68,11	2,95	1,00	1,56	1,22	0,100	11,30	0,035
Magnitogorsk Ore	55,16	9,89	12,16	66,25	2,99	2,74	0,27	0,93	0,103	4,11	0,044
Atasui Ore	54,2	15,50	2,88	74,06	1,53	0,66	0,67	0,45	0,411	3,24	0,104
Akhtensk Ore	41,6	22,50	1,52	59,38	2,62	0,58	1,38	0,85	0,131	9,80	0,041
Sokolov-Sarbai Ore	60,99	6,70	13,78	71,90	1,24	1,35	0,20	1,21	0,24	2,23	0,225
Limestone	1,39	0,88	—	1,80	0,49	53,70	0,12	0,73	0,049	42,03	0,008

Materials to be smelted differed markedly among each other with respect to their metallurgical properties. Reducibility of the iron ores and sinters, as determined by the M.M.C. method (Magnitogorsk Metallurgical Combine), varied 25-80%. Moreover the softening temperature of these charge components varied substantially. Both these factors influenced adversely the reduction and smelting process; the slag-formation zone moved noticeably up and down the furnace. The use of Bakal-Deposit limonites which contain a large fraction of fines and a high moisture tended to plug up the central portion of the charge column and interfered with the proper gas-flow distribution throughout the furnace volume.

Use of Bakal siderites had a detrimental effect on the smelting process. Decomposition of siderite required additional heat resulting in cooling of the charge which in turn necessitated decreasing the ore charging rate. At present (when use of sinter has been introduced) utilization of siderites in the raw form is not expedient.

Under such adverse conditions the furnace operated during the first months after blowing-in. Starting with January 1959 the number of charge components was reduced to 3-4 because the share of sinter in the charge was increased. In the following months the fraction of sinter in the ore charge was raised to 85-90%. This fact reflected favorably in the smelting-performance data.

TABLE 2

Average Furnace-Operating Data

Indices	November December	1959 I quarter	1959 II quarter	1959 III quarter	1959 IV quarter	1960 I quarter	1960 April May
"K.i.p.o."	0,962	0,825	0,770	0,778	0,775	0,729	0,735
Index of Smelting Intensity, Kg/m³ per day:							
for the nominal time	878	910	916	947	897	955	930
for the actural operating time	906	923	928	962	901	—	—
average iron content in charge	45,58	48,17	49,01	47,93	45,77	45,1	45,7
Raw material consumption, kg/ton of pig iron:							
dry coke	838	739	695	713	690	724	689
sinter	740	1351	1773	1950	1774	1754	1745
raw ore	1605	801	345	269	441	463	330
limestone	388	282	181	101	107	114	95
slag tapped, kg/ton of pig iron	981	899	842	869	846	824	821
flue dust production, kg/ton of pig iron	32	53	63	70	54	55	62
Blast:							
rate (consumption); m³/ton	2848	2871	2880	2762	2757	2920	2959
temperature, °C	838	902	890	884	937	941	937
pressure, atm.	2,43	2,59	2,47	2,04	2,97	2,59	2,63
moisture content, gm/Nm³	17,7	22,6	23,7	26,6	25,0	24,5	27,3
blast furnace gas:							
temperature, °C	177	235	318	317	309	274	309
pressure, atm	1,21	1,33	1,26	0,73	1,27	1,22	1,23
composition, %:							
CO_2	14,5	14,6	14,2	14,5	14,5	14,2	13,7
CO	27,5	27,7	27,6	27,3	27,0	27,8	27,7
CH_4	—	0,48	0,50	0,50	0,49	0,49	0,50
H_2	2,55	2,23	1,97	1,73	2,12	1,97	2,18
pig-iron composition,%:							
Si	0,84	0,87	0,82	0,87	0,91	0,91	0,92
Mn	1,06	0,95	0,92	0,97	1,00	0,96	0,93
S	0,047	0,046	0,039	0,038	0,038	0,04	0,033
slag composition, %:							
SiO_2	39,51	39,27	39,38	39,67	40,09	40,34	40,56
Al_2O_3	14,48	14,44	14,93	14,88	14,07	14,44	14,44
CaO	36,60	38,11	38,07	37,73	38,25	36,94	37,93
MgO	5,82	5,72	5,03	5,41	4,79	5,50	5,33
MnO	1,66	1,49	1,30	1,54	1,48	1,49	1,28
FeO	0,48	0,43	0,35	0,31	0,49	0,36	0,28
S	0,59	0,53	0,57	0,45	0,56	0,49	0,40
number of bankings	15	38	7	29	3	11	9
number of blast tuyeres changed	31	19	11	16	18	26	41
number of slag holes changed	5	14	9	14	24	24	9

The basic economic and technical performance data on the furnace operation from November 1958 to May 1960 are shown in Table 2.

During the first two months of operation when the furnace produced pig iron for hot-metal use, its productivity was low and coke consumption was the highest of the whole period. The charge contained only 30-33% sinter which was largely brought in and which was poorer in iron than the local sinter. During this period there were cases of disruption of furnace operation which were accompanied by drastic cooling down which led to the flooding of tuyeres by slag. One of the reasons for plugging the crucible was the operation with 200 mm diameter tuyeres. As of November 22nd 170-180 mm tuyeres have been installed.

During November and December it was apparent, judging by the composition of the shaft gas along the furnace diameter, that the furnace center was blocked by ore. Attempts to eliminate this blockage by changing the charging regime and charge level were fruitless until the use of 80% sinter in the charge was initiated.

In the period of January to April 1959 furnace operation indices improved significantly as a result of the improved charge. The proportion of sinter in the charge increased from 52.3% in January to 88.8% in April. The iron content increased to 48-49%, the coke consumption decreased from 778kg/ ton of pig iron in January to

709 kg /ton in April, the amount of blast increased slightly, the top pressure was raised to 1.4 atm, and the gas-flow distribution improved. However, just as previously, there was channelling in the furnace. During these months the blast temperature was increased.

Good productivity was obtained in May 1959. From the 7th to the 31st of May the furnace operated on coke of a higher quality, the tumble test was 318-319 kg. The operating practice was the same as in April other than that the blast temperature was about 21° higher. The productivity increased during May by 1.8% (in comparison with April) even though the charge was 2.2% lower in iron.

The sinter fraction in the charge was also lower by 1.4% during May, whereby the consumption of local sinter (which is higher in iron and is lumpy) was lower. The increase in productivity resulted basically from lowering the coke consumption by 28 kg/ton of pig iron and in some measure from the increased blast temperature.

During June to September 1959 the furnace operated with a reduced top pressure because in June material began to be blown out of the space between the bells when the small bell was being opened. This was so because the large bell and the cup burned through. Accordingly the top pressure was lowered, initially to 1.0 atm and later to 0.7 atm. The furnace was shut down and the holes in the cup and the bell were welded up. After the overhaul, the top pressure was 1.0 atm and later it was again lowered to 0.7 atm. The furnace operated at the 0.7-0.8 atm pressure until the charging mechanism was changed in October 1959. During this period raising of the local sinter basicity to 1.0 was of major significance.

At the beginning of November the charging mechanism was changed. A new large bell of modified design was installed; this new bell had the angle of its lower end, which contacts the cup well, increased from 55 to 62°. After the replacement of the charging mechanism the top pressure was raised to 1.3 atm.

From the 12th to the 25th October a sinter, which was made by the local plant in cooperation with the "NIIM" Ore-Raw-Material Laboratory, and which had an average $CaO : SiO_2$ ratio equal to 1.42, was used. The strength of this sinter was somewhat lower than that of the common sinters. The average productivity in October was the same as in May in spite of the face that during the latter month a test with high-strength coke was on.

The average coke consumption during the month was 692 kg ton of pig iron, while during the test run it was 677 kg/ton. Because of the higher sinter basicity the limestone consumption during the above-mentioned days was 5-8 kg/ton of pig iron (when sinter basicity was 1.0 the lime consumption was 100-150 kg/ton). The blast temperature was on the average 946° throughout the month, i.e., it was higher than any other during the preceding period of furnace operation. Accordingly the experimental smelting period shows once more that the use of self-fluxing sinter improves furnace operation significantly.

In November 1959 there was an experimental run based on coke charges likely to be used in the years 1962-1965. 20% gas-coal was introduced into the coke-oven charge (6-10% is usual). The coke thus obtained was weaker, its tumbling index was erratic, averaging 312 kg while the minus 10 mm fraction under the drum was 36 kg. The pressure drop between the tuyeres and the top increased from 1.2-1.25 atm in October to 1.35-1.45 in November. Furnace productivity decreased by 2.7%. Coke consumption in November was 0.8% lower than in May. Uneven furnace operation and crucible blockage which accompanied the use of this coke resulted in sharp fluctuations in pig iron composition (Si: from 0.6 to 1.4). The test with the future-type coke has indicated that smelting on such coke would significantly degrade the productivity indexes.

The best performance was obtained in 1960; and this resulted from increasing the quantity of blast and the ore charge. The "K.i.p.o." was reduced to 0.726 and the index of smelting intensity increased to 950-963 kg/m^3 a day while the coke consumption was relatively low (669-684 kg/ton). The blast temperature was at a higher level than in 1959 (940-956°). The improvement in the productivity performance in 1960 was also favored by the increases that were made in the sinter basicity and reductibility while its strength as measured by a drum tumbling test was not reduced.

Characteristics of Furnace Operation. Control of the Operation

During the first month of operation coke charges weighing 8.6 and 7 tons were experimented with. In January a coke-charge weight of 6.7 tons was standardized and the furnace operated with it throughout 1959. It was not possible to further reduce the size of the coke charge as the skip hoist then could not keep up the charge supply. Various charge levels, in the range of 1.25 to 2.0 m, were tested. Best results were obtained at a charge level of 1.5 m which was then accepted as optimum.

The charging scheme, set in the first days of operation was OOCC↓(Ore, Ore, Coke, Coke), yet it was soon abandoned and the system 4 OOCC↓ 3 COOC↓was adopted. Beginning with January 1959 the basic system was COOC↓and the system CCOO↓and OOCC↓was used for controlling furnace operation.

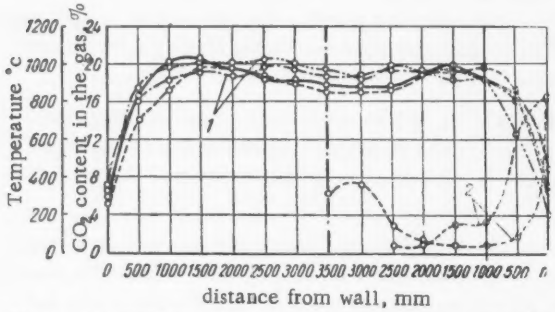

Fig. 1. CO_2 content in the gas and temperature along the upper-shaft radius, when operating on a 30-40% sinter charge: 1) CO_2 content in the gas; 2) gas temperature.

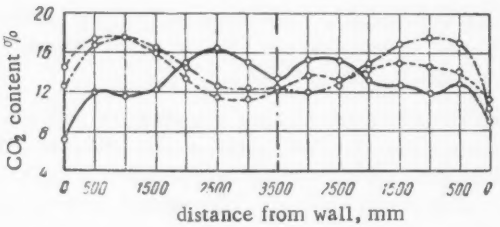

Fig. 2. Changes in CO_2 content in the gas along the upper-shaft radius when the sinter content in the charge was 85-90%.

When the operation was on a poorly prepared charge (60-70% raw ore) it was accompanied by blockage in the furnace center. This was evidenced by the increase of CO_2 in the dome gas at the furnace center to 20-22%, and presence of CO in the crucible gas at a distance of 2 mm from the tuyere outlet (up to 60-65%).

Figure 1 gives a graph of changes in CO_2 concentration in the gas along the diameter in the upper portion of the furnace, during the first months of furnace operation. During this period the attempts to control the gas-flow distribution by means of the charging scheme, the coke charge size and the charge level were not successful. It was possible to obtain a more or less proper gas-flow distribution only after charge quality was improved, i.e., when the percentage of sinter was increased (Figure 2). The axial portion of the furnace could be loosened up only when 80% sinter was used in the charge. The pressure drop between the bustle pipe and the furnace top decreased from 1.4 to 1.2-1.25 atm.

The flow at the periphery remained constant throughout the whole period of furnace operation. Changes in the charging scheme began to influence the nature of the gas-flow distribution in the charge column at sinter content of 80-90%. The chemical energy of the reducing gas was utilized well, as evidenced by the fact that the top gas contained more than 14% CO_2. This allows the conclusion to be drawn that the ratio of profile parameters for this large-volume furnace was well chosen.

The furnace operated comparatively smoothly on a charge of 80-85% sinter and a blast rate of 3200-3300 m^3/min at a furnace-top pressure of 1.4 atm and a blast temperature of 950-1000°, yet at times channelling and unstable operation did occur. To eliminate these it was necessary to reduce the top pressure and to reduce the blast rate and temperature. Channelling was frequently accompanied by the appearance of slag in the tuyeres. The frequent formation of channels in the charge column and the blockage of the furnace center which accompanied the former may be explained by the increase in the furnace cross section (as compared to smaller volume furnaces).

Attempts to speed up the furnace operation by increasing the blast rate to 3500 m^3/min were unsuccessful and led to upsets in the operation and to flooding of tuyeres with iron-containing slag.

Accordingly this experimental operation indicates that such a large furnace is very sensitive to charge quality and that it is imperative to operate on well prepared materials. Further forcing of the furnace operation through increasing the blast rate may be achieved when the amount of fines in the sinter is reduced. For this it is necessary to improve the sinter quality, i.e., its strength and to screen off fines of less than 5 mm.

Condition of the Furnace Crucible

In November 1958 when the furnace operated with 200 mm diameter tuyeres and the charge contained 70% raw ore and siderites frequent blockage of the crucible and flooding of tuyeres and jets with slag and pig iron occurred. The reasons for crucible blockage were the following: the very strong peripheral gas flow with simultaneous solidification of the central portion of the charge column, and the insufficient air-discharge velocity from

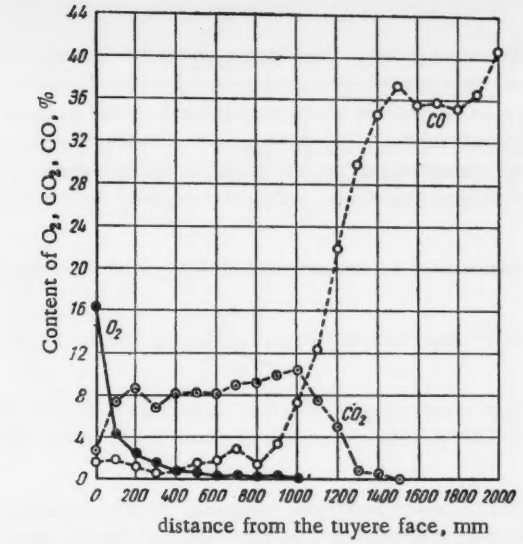

Fig. 3. Gas-composition changes in the combustion zone, with the furnace operating smoothly.

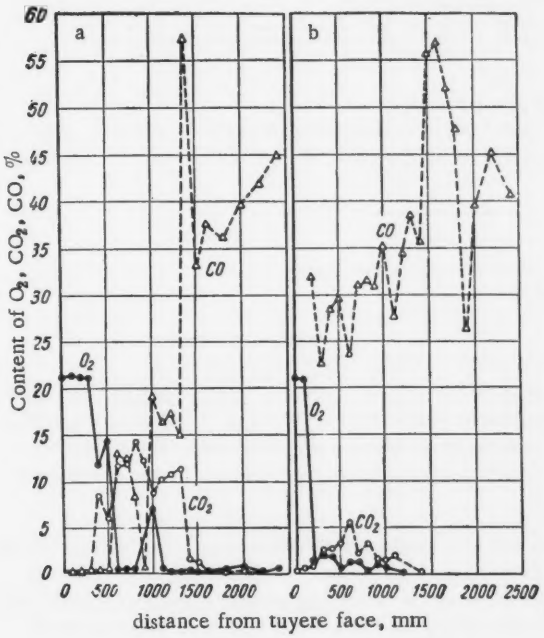

Fig. 4. Gas-composition changes in the combustion zone when crucible blocking occurred: a) on November 18, 1959, b) on November 20, 1959.

the tuyeres which were 200 mm in diameter. Actually the discharge velocity in this large furnace was the same as in other blast furnaces in the plant while in fact the discharge velocity should be much larger for proper operation of furnaces with a large cross-sectional area. In order to increase the blast discharge velocity 170-180 mm tuyeres were installed. Operation with such tuyeres had reduced the danger of their being flooded with slag and this because of the higher blast velocity. Later, when the operation was on a charge containing 80-85% sinter, 180 mm tuyeres were used.

The flooding of tuyeres with slag and pig iron was encountered also subsequently and this when channelling in the charge column occurred. The slag appeared in the tuyeres relatively soon (1.5-2.0 hr) after channel formation. In order to eliminate the channelling the blasting rate and temperature were usually reduced and simultaneously the moisture content in the blast and the top pressure were lowered.

The appearance of channels was accompanied by a sharp decrease in the silicon content of the pig iron (to 0.3-0.4%). When channels were eliminated the silicon content rose just as sharply and this without the use of dummy charges or decreasing the ratio of ore in the charge.

Investigation of gas composition in the blast-furnace crucible indicated that during smooth operation the carbon monoxide content at a point 1500-2000 mm from the tuyeres did not exceed 40% (Figure 3). When the crucible became blocked, the carbon monoxide content at the same point rose to 60-70%. During smooth furnace operation and a top pressure of 1.4 atm the height of the oxidizing zone (up to the 2% CO_2 content) was 1270 mm. Under conditions of forced operation when the dome pressure was 0.7 atm (because of leakage in the charging mechanism) the combustion zone increased to 1350 mm. When operating on weak coke, made from a coal charge containing 20% high-volatile coal, the crucible became blocked with coke breeze. Much pig iron flowed out with the upper slag and burning of slag tuyeres occurred. When pig iron was tapped much coke breeze came out with the slag. That blocking of the crucible existed is shown by the graphs of crucible gases (Figure 4).

On November 18th the extent of the combustion zone was not great; at a distance of 200-500 mm from the tuyeres there was already 23-32% CO, and at a distance 1600 mm the CO content reached 57%. On November 20th there was also a high carbon monoxide concentration in the gas at a distance of 1500 mm.

Experimental operation of the furnace with a 9100 mm diameter and 18 tuyeres showed that in order to have normal furnace operation (in the crucible area) it is necessary to choose the tuyere diameter correctly.

A series of factors has a negative influence on the operation of large blast furnace crucibles. Among these are increased number of tuyeres and increased top pressure. On the other hand these very factors are essential for an intensified smelting rate; thus it is essential to have a good preparation of charge materials. When an insufficiently prepared charge is to be used the tuyere diameter should be somewhat smaller than on well prepared charges. This will ensure a deeper blast penetration into the furnace crucible and will prevent development of a too intensive peripheral smelting. In the latter case, according to experience, attempts to regulate the gas flow "from the top" do not give desired results.

Based on a one-and-one-half year's experimental operation of the furnace the following conclusions may be drawn:

1. Technical and economic indices for the operation of large-volume furnaces are higher than for small or medium size furnaces

2. For smooth furnace operation a well prepared charge is necessary (85-100% of increased basicity sinter) and coke of high mechanical strength (tumbling test of 320-330kg and an undersize of minus 10 mm of not more than 35-36kg).

3. The furnace profile is fully satisfactory with respect to contemporary raw materials. With the existing profile and charging mechanism and operation on 80-85% sinter it is possible to regulate the gas flow by varying the charging mode.

THE MOVEMENT OF LADLES DURING SINGLE-SPOUT POURING OF PIG-IRON

L. Ya. Shparber, and A. I. Dorman

Magnitogorsk Metallurgical Combine
Translated from Metallurg, No.12,
pp. 10-11, 1960

The introduction of single-spout pig-iron pouring necessitated the development of a method of moving the ladles under the stationary spout. Figure 1 shows an arrangement for the transportation of ladles designed by the Design Department of the Magnitogorsk Metallurgical Combine for a blast-furnace shop consisting of two blast-furnaces. The positioning of the ladles as shown on the drawing corresponds to the movement when the pig-iron is being tapped from Furnace A.

The plant is equipped with a reversible hoist which provides for the transportation of cars weighing 535 tons. The pulling force applied to the cars is 6500 kg. An endless rope, which passes through guiding and stretching pulleys, is attached to the drum of the hoist. The distance between the stretching pulleys is adequate for the four ladles to be placed on the delivery rail track and to be moved along the track. The fifth ladle remains on the second rail track under the stationary spout. A suspension section is attached to the rope and has a ring which is attached by the hook welded to the carriage of the hot metal car.

Before the tapping of pig-iron the ladles are set up as shown on Fig. 1. The furnace attendant than attaches the suspension section of the rope to the hook on ladle No. 4. The movable runner is in the position indicated by continuous lines in Fig. 1. In this position the equipment is ready for operation.

Ladle No. 1, which is under the stationary spout, is filled first. When the first ladle is full, the movable runner is placed in the position as shown by broken lines in Fig. 1, and hot metal is run into ladle No. 5 which is then under the movable spout. At the same time the ladles are moved by means of the hoist toward furnace A and thus ladle No. 2 comes under the stationary spout. The movable runner is again placed in the original position and hot metal is run into ladle No. 2. When ladle No. 2 is full the movable runner is again placed under the

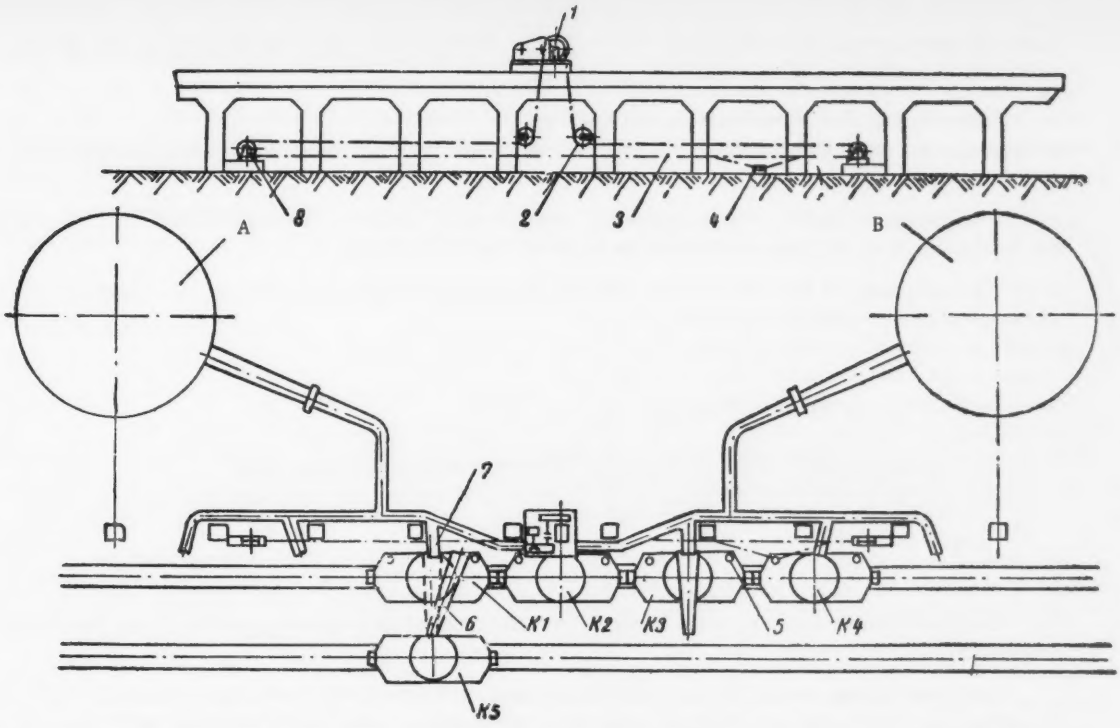

Fig. 1. Diagram showing the arrangement of the hoist: 1) Hoist; 2) pulley; 3) rope; 4) suspension section with ring; 5) hook; 6) movable runner; 7) stationary spout; 8) stretching pulley; A,B) blast furnaces; K1–K5) ladles.

Operation	Time, min
	2 4 6 8 10 12 14 16 18 20 22 24 26 28 30 32
Filling ladle No. 1	
Turning the movable runner	
Moving and placing ladle No.2 under the stationary spout	
Turning the movable runner	
Filling ladle No.2	
Turning the movable runner	
Moving and placing ladle No.3 under the stationary spout.	
Turning the movable runner	
Filling ladle No.3	
Turning the movable runner	
Moving and placing ladle No.4 under the stationary spout.	
Turning the movable runner	
Filling ladle No.4	
Filling ladle No.5 in three stages	

Fig. 2. Operation schedule for the movement of ladles.

stationary spout and the ladles are moved. In this way, to fill four ladles placed on the pig-iron delivery rail track it is necessary to move the ladle cars three times.

The technical data of the hoist are given below:
Lifting capacity, ton,8.0; Reducing gear type, TsD2-65; Motor type, AO82-6; Motor capacity, kw, 28.0; Speed of motor, rpm, 980; Speed of the rope, m/min, 13.9.

The operation schedule of the equipment is shown in Fig. 2. It is seen that the total time which is required for the movement of the ladles is adequate for the ladle No. 5 to be filled.

The equipment for the movement of ladles has been in operation for over two years; it is simple in design and convenient and reliable in operation.

A TEAM OF COMMUNIST LABOR

A. I. Belyakov. The Secretary of the Party Branch at the Blast Furnace Shop.

Translated from Metallurg, No.12,
pp. 12-14, 1960

The blast-furnace operators of the Cherepovets Works improve their operating efficiency and increase their output of pig-iron continuously.

The blast-furnace shop of this Works is relatively new; in August 1960 it had completed only five years of operation. But even in this short time the personnel of this shop have succeeded in achieving very impressive production figures (see table).

In 1960 the technical and economic indices of the shop operations have improved considerably. Thus, for instance, the ratio of the blast-furnace volume to the daily output for the first half of the year constituted 0.588 at this shop, and for August it was 0.545.

The productive efficiency in 7 months of 1960 increased by 13% in comparison with the corresponding period of 1959.

The coke consumption has been reduced considerably and at present it is 563 kg/ton of pig iron. The cost of production is reduced continuously; thus for instance the cost of 1 ton of conversion pig iron in July 1960 constituted 370 rubles 87 kopecks which is 2.2 times less than the cost in 1955. This was the result of reducing the consumption of materials per ton of pig iron (owing to improved methods) and also the consequence of a better quality of raw materials and fuel, the reduction in idle periods of the furnaces and in losses of pig iron.

We must admit that Cherepovets pig iron still continues to be more expensive in comparison with pig iron from other blast-furnace shops (especially in comparison with Magnitogorsk pig iron), but the main reason for its high cost is the great distance from the raw material sources.

The foremen of the blast-furnace shop at the Cherepovets Works succeeded in achieving an exceptionally even blast-furnace operation and this is also one of the factors contributing to increased output of metal.

Initially we had to overcome considerable difficulties. The foremen of the blast furnace came from various blast-furnace shops in the country; there was no one uniform "style" of operation; the majority of the workers at the shops had no idea of the work at metallurgical plants. On top of this it was necessary to master the furnace operation with fluxed sinter which at present constitutes 100% of the ore portion of the blast-furnace charge.

Every year the blast-furnace operators at the Cherepovets Works more than fulfill the obligations which they undertake in the socialist competitions.

At the beginning of 1960 they undertook to produce 32,000 tons of pig iron over and above the planned quota. Recently the personnel of the shop revised these undertakings and decided to complete them not at the end of the year as was planned but somewhat earlier.

The Party and the Trade Union organizations at the shop have organized socialist competitions extensively, and the results are announced every month. Every worker knows the result of the work he has done the previous

day. Posters are displayed to show what the daily output of pig iron should be in excess of the planned quota necessary for the fulfillment of the obligation undertaken, and on the same posters every day the figure showing the quantity of pig iron produced over and above the planned quota is also displayed. Extensive publicity given to the competition assists in improving the operating efficiency and encouraging the personnel toward the successful fulfillment of the obligations undertaken.

In socialist competitions this year, the blast-furnace shop won first place 6 times and won the Challenge Red Banner of the Works Trade Union Committee and of Works Administration.

Average Annual Operation Data of the Blast-Furnace Shop since the Start of the Operation

Item	Year				
	1955	1956	1957	1958	1959
Ratio of blast-furnace volume to daily output, m³/ton.	1,330	0,840	0,712	0,631	0,609
Coke consumption per 1 ton of conversion pig iron, ton	0,873	0,720	0,682	0,601	0,596
Pressure of the gas at the blast-furnace top, atm	0,170	0,85	1,300	1,470	1,5—1,8
Temperature of the hot blast, °C.	700	785	900	983	1014
Cost of 1 ton of conversion pig iron, rubles	813,5	612,9	500,06	447	423

The increase in pig iron production and hence successful fulfillment of socialist obligations was achieved by operating the blast furnaces at a high gas pressure at the blast-furnace top (1.5 and 1.8 atm) which made it possible to increase the air and gas rate to the furnace. Also, because of a high temperature of the blast (up to 1020-1040°C) the consumption of coke was reduced considerably and the cost of pig iron was lowered.

The highly efficient operation of the blast-furnaces is also indicated by the fact that the dust carry-out constitutes only up to 15 kg/ton of pig iron. The blast furnaces at our Works have been adapted for 9-stage pig-iron tapping. The tapping of the metal in accordance with the time schedule is imperative and is always adhered to. The Party organizations at the shop lead the fight for technical progress, for the introduction of modern equipment and advanced methods. After the resolution of the July Plenary Session of the Central Committee of the CPSU, the operation of the blast-furnace stoves at one of the blast furnaces was automated, and soon the change-over to single-spout pig-iron pouring will be completed.

On the suggestion of the shop head assistant V. D. Nikitin and some other workers, two rubber conveyers for the delivery of raw materials have been replaced by metal conveyers and this has resulted in a longer service life of the conveyers, saved more than 360,000 rubles annually and made the work of the operators in the loading section easier. The delivery of the materials for the maintenance of the slag notches at one of the blast furnaces has been mechanized; the same improvements are also being carried out at the second blast furnace.

An impressive contribution to the technical progress is made by innovators and inventors. Their number increases continuously; at present every fourth worker at the shop is an innovator. The savings made by putting new suggestions into practice constituted more than 500,000 rubles for 8 months of 1960.

The most active innovators at the shop are blast-furnace foreman N. D. Sapozhnikov, blast-furnace attendants A. I. Gutorov and M. A. Samukhin, mechanic P. A. Tsvetkov, electrician I. D. Chuprikov, pipe-fitter V. F. Rozin, mechanic A. L. Ivanov and many other workers.

An active fight to economize electric power, raw materials and other utilities is also under way. Thus, for instance, the replacement of the bronze nuts of the tipping mechanism of the slag cars by compound nuts saved approximately 1.5 tons of bronze and several tens of thousands of rubles per year. Previously, burnt tuyeres were sent from the shop to be remelted. On the suggestion of I. G. Gnezdilov, V. D. Nikitin and P. P. Rumyantsev the mechanics at the shop, the copper is used again for the production of slag nozzles.

The ore handling equipment at the loading section has been modified on the basis of the experience of other blast-furnace shops, in particular of the Kuznetsk Combine.

In 8 months of 1960, 490,000 kw-hr of electricity was saved while the personnel undertook the same 600,000 kw-hr over the whole year.

The July Plenary Session of the Central Committee of the CPSU pointed out in their resolutions that it is essential to give annual support to innovators and leading workers and to introduce advanced production methods

extensively. In 1959 and the first half of 1960 five courses for advanced production methods were held at the shop. The courses were arranged for the workers of the machine maintenance section, loading section for furnace attendants and others, and were attended by 110 men. These courses assisted in improving operating efficiency. In addition, some of the workers improved their knowledge by other methods of study. All the blast-furnace attendants have learned the duties of the crane operators at the casting yard as their second trade.

A 5-year plan for increasing the general educational level of all categories of workers and technical personnel at the shop has been worked out. A mass movement of the workers at the shop toward an improvement in general knowledge, technical and cultural level and practical and industrial education has been started.

Our successes have been achieved by intense creative effort with the active support of the personnel from other shops at our Works and all blast-furnace operators all over the country whose work and progress is carefully followed and whose new ideas are studied and adopted by the Cherepovets blast-furnace operators.

All the best and advanced techniques used by blast-furnace operators in the Urals, Siberia and in the South are utilized in our Works. Recently, the foreman of the blast furnace shop, V. M. Antonov, a senior blast operator, K. M. Bugaev and a senior furnace attendant K. G. Mel'nikov spent one and a half months at the "Zaporozhstal'" Works as part of the exchange-of-information program. At the same time the staff of the "Zaporozhstal'" Works studied the methods of the Cherepovets workers.

The Communist Part carried out a big educational job in developing the unity among the workers at the shop and succeeded in organizing the personnel in the fight to fulfill the production plan and the socialist undertaking. Among its personnel the shop has remarkable specialists whose effort have helped toward a successful solution of our tasks. These are: blast-furnace foremen V. M. Antonov, V. N. Tsukanov, N. P. Sapozhnikov, I. A. Novikov, S. S. Kulyakin, senior blast operators K. M. Bugaev, R. N. Appolonov, senior furnace attendants K. G. Mel'nikov, I. G. Kolobov, N. A. Samuchin, V. I. Zhil'tsov, scale car operators N. V. Tumanov and V. E. Efimov, and other workers. An efficient operation of the blast furnaces depends largely on mechanics, electricians and other auxiliary workers at the shop who, by proper maintenance, achieved very low idle periods of the equipment (0.49% of the nominal operating time in the first half of 1960 and 0.04% in August, 1960).

It would not be right to say that there are no shortcomings in our work. The successes we have achieved give us no feeling of complacency. We have decided to attain new and better results: by making use of potential sources of production increase at the shop we intend to reduce pig iron losses, reduce the idle time of operating equipment, and introduce mechanization of industrial processes extensively. We intend to achieve two years ahead of schedule the ratio of blast furnace volume to daily output planned for the end of the Seven-Year Plan.

In September 1959, the personnel of our shop entered the competition to win the title of the "Shop of Communist Labor." In one year the blast-furnace operators achieved new successes in all aspects of blast-furnace production. These successes were highly praised and in August 1960 the shop was awarded the coveted title of "Team of Communist Labor." We now feel obliged to do even better. In response to the trust shown to us, the blast-furnace operators at the Cherepovets Works will make a worthy contribution to the completion of the 7-Year Plan ahead of schedule.

MECHANIZATION AT THE MAGNITOGORSK METALLURGICAL COMBINE

V. P. Emel'yanov

Translated from Metallurg, No.12,
p. 14, 1960

The removal of the remainder of the charge from the furnace is one of laborious operations during major overhauls of blast furnaces. A large number of workers have to be employed on this operation and it involves a considerable period of time which increases the cost of repairs.

The erection of special screens needed for the explosion operations is especially expensive. During every major overhaul the welding and erection of steel screens alone cost about 50,000 rubles.

On the suggestion of the staff of the Magnitogorsk blast-furnace shop and the Uraldomnaremont, the Magnitogorsk Metallurgical Combine employs hydromonitors for the removal of the charge. This method assists in the efficient cooling of the remainder of the hard "scull" and makes it more amenable to blasting, so that it is possible to carry out the blasting operation without the erection of shielding screens.

With the introduction of the hydraulic treatment there is no longer any need for cooling the foundation block of the blast furnace during the repairs, and hence no need to lay piping and install water hoses.

As a result of adopting the above suggestion, the duration of major repairs has been reduced by 15-20 hours and this, together with a saving in materials and manpower, saves about 100,000 rubles on a single major overhaul.

NEW BOOKS

G. G. Oreshkin. The Problems of the Rationalization of Blast Furnace Operation.

Khar'kov, Metallurgizdat, 1960, 189 pages
Translated from Metallurg, No.12,
p. 14, 1960

The author of this book, now the director of the Dzerzhinskii Works, is a well known blast-furnace expert. He devoted much attention in his book to the distribution of charge materials in the blast furnace. In the chapter devoted to this problem we find a description of the investigations on the gas permeability of the charge carried out at the Dzerzhinskii Works, and a discussion of the character of the descent of the materials from the large bell into the furnace and the effect of various factors on the distribution of the gas stream. On the basis of all this data, ways of controlling the gas stream are recommended. These are: the variation in the size of the blast furnace top, the change in the order of charging the materials into the furnace, etc.

The book deals in detail with the problem of the rational contour of the blast furnace. By analyzing published data and the results of the practical operation of blast furnaces, the author puts forward interesting ideas regarding the rationalization of the contour taking into account the brickwork erosion and the cooling system.

A separate chapter is devoted to the formation of encrustation in the blast furnace. The last chapter of the book deals with experimental work on the improvement of blast-furnace production. The author describes the cooling of the blast furnace gases with a fine water spray, the production of low-manganese pig-iron with coke made from Donets coal, the injection of pulverized coal fuel into the blast-furnace hearth, the testing of the revolving distributor. There is also a description of the design of a 3-bell charging apparatus and a machine for roasting limestone.

The book by G. D. Oreshkin will undoubtedly be of interest to engineers, foremen and skilled workers and blast-furnace operators generally as well as to students in metallurgical departments at universities.

A. G.

THE USE OF OXYGEN AND COMPRESSED AIR AND THE LIFE OF REFRACTORY LINING

(FROM WORKING EXPERIENCE OF THE OPEN-HEARTH FURNACES AT NTMK)

M. M. Dvorkind, G. Kh. Iskhakov, N. S. Redin,

Zh. A. Vydrina, and T. N. Bushueva

Nizhnii Tagil' Metallurgical Combine (NTMK) and the Eastern Refractories Institute

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pp. 15-17, 1960

The introduction of oxygen and compressed air as an intensifier, together with the accomplishment of a number of measures to improve the technical working details of open-hearth furnaces at NTMK has shown a real possibility of increasing the life of roofs and other elements of the furnace lining by 1.5-2 times.

In large capacity furnaces, the average life of basic periclase-spinel and magnesite-chrome roofs before the introduction of oxygen was 322 melts (from 11 completed campaigns); with oxygen fed into the flame 419 melts (from 31 completed campaigns). The maximum roof life with oxygen fed into the flame was 527 melts, and with oxygen fed into the flame and into the bath, 497 melts.

In small furnaces working with compressed air fed from one compressor, the average roof life was 451 melts; with oxygen fed from two compressors, 564 melts, and from three, 667 melts. Similarly, the maximum roof life with compressed air fed from one compressor was 526 melts, from two, 652 melts and from three, 740 melts.

The life of other elements of the lining was also considerably increased. Thus, the life before full replacement of the regenerator brickwork increased from 336 to 442 melts and in small furnaces on the average from 510 to 667 melts.

The replacement of the Dinas (a silica refractory) lining of the working fantail arches of slag-pockets and partially of regenerator roofs by unfired magnesite-chrome made it possible to increase the life on the average from 804 to 1751 melts, that is, by 218%.

Together with the increase of the campaign duration, the production capacity of open-hearth furnaces also rose. Compared with 1956, on the average, for furnaces working with the use of oxygen, production capacity rose by 22.3% and on furnaces working with compressed air, by 17%. At the same time, the ideal fuel consumption was reduced by 12 and 9% respectively. The specific consumption of refractories for all elements of the lining was reduced in large capacity furnaces by 38.3%, and in small furnaces by 35.5%, including for the roofs 18% and for the regenerator brickwork 6%.

As a result of the increase in life of the lining elements, the number of cold repairs which had to be carried out per year of working the plant was reduced.

On one large capacity furnace in 1955, 2.4 cold repairs had to be carried out, but in 1959-1960, 1.57; that is, the amount of repairs was reduced by 34.5%: on medium and small furnaces the corresponding figures are 20 and 44.7%.

Despite a certain increase in the number and time taken in large hot repairs, the total lost working time for the combine as a whole has been reduced by up to 40%.

The reduction in the volume and time taken in cold repairs has lead to a considerable saving in State resources. The daily expenses on repair of open-hearth furnaces, working with the use of oxygen and compressed air, were respectively 38 and 17.5% lower than in operating furnaces without a booster.

Measures carried out by the combine and by the Eastern Refractories Institute were of great value in raising the life of roofs and other furnace lining elements. These were: increasing the roof rise from 1350 to 1450 mm; altering the design of locating the roof corners and developing a safer and convenient roof bracing; creating a stable and flat flame and a more oxidizing atmosphere by feeding compressed air and oxygen into the furnace head; reducing time lost in hearth repairs and laying down a chart of intermediate repairs; improving the heat regime in the periods of the melt; improving head and roof maintenance, the mechanization of slag removal from the slag pocket, the rationalization of furnace repairs, etc.

In generalizing on experience in the use of oxygen, an appraisal was made of the change in working conditions upon feeding oxygen into the flame and bath. It has been established that the most dangerous factor is the fall in temperature on the working surface of the roof at the moment of cutting off the fuel (during valve change-overs) both with and without the supply of tar. The rate of temperature rise at the roof working surface upon switching on the fuel after change-over is increased by a factor of 2-3 (in comparison with working the furnace without tar). The maximum temperature of the roof working surface in using oxygen with tar (700-900 kg/hr) in all the melting periods is increased by 50-70°C, and the temperature of the liquid steel and slag during the blowing of the bath with oxygen is raised by 40-50°C.

It has been established that the use of complex automation (according to the VNIIMT* scheme) to regulate the temperature regime of an open-hearth furnace stabilizes the temperature regime in all the periods of the melt, creating a narrower temperature interval (1500-1600°C) which evidently also brings about an increase in the life of lining elements.

In the space under the roof of the open-hearth furnace in conditions of supplying oxygen simultaneously into the flame and into the bath, carbon monoxide serves chiefly as a reducing agent, the maximum content of which in the center and rear lines of the roof, in the period of the oxygen-blow and pouring in the pig iron, reaches 12%. Thus the atmosphere in the space under the roof in conditions of working the furnace with oil, in all the periods of the melt, is more reducing.

The rate of flow of the combustion products in the space under the furnace roof in the period of blowing the bath with oxygen is increased 2-2.5 times.

In studying the change in the concentrations and composition of the furnace dust in the space under the furnace roof, as it depends on the melting period and method of oxygen supply, an increase in the ferrous oxide content in the furnace dust was noticed in the bath blow. This is evidently explained by the fact that the transfer of iron into the furnace atmosphere goes on so intensely that even the oxygen fed into the flame and into the bath is inadequate to transfer all the iron into the higher-oxide form. Iron oxides in the working zones of brickwork, in the process of using the furnace (oxidizing or reducing medium under the roof), can change from the higher-oxide form to lower-oxide and vice versa. This gives rise to volume changes in the working zone and contributes to erosion of roof details. It is typical that, in supplying oxygen simultaneously to the flame and to the bath, roof erosion takes place more uniformly in the breadth of the furnace than if oxygen is supplied only to the flame. In conditions of working the furnace with oxygen supplied only to the flame, the roof is largely worn away along the front wall. The uniform erosion of the roof is explained by the fact that in blowing the bath with oxygen, an increased concentration of furnace dust and a more reducing medium along the back wall are observed: this causes the increased roof wear.

The results of prolonged use of basic refractories in the lower constructed parts of open-hearth furnaces working with the use of oxygen indicate that the use of unfired magnesite-chrome details for the roofs of slag-pockets and regenerators is very desirable. This promotes a substantial increase in their working life as compared with Dinas brickwork, reduces the extent of intermediate repairs, and facilitates the cleaning of slag-pockets and regenerator brickwork from furnace dust.

In working air and gas regenerator brickwork (in conditions of blowing, flushing and temperature of the top of the regenerator brickwork up to 1350°C) with unfired forsterite, as compared with fired, the structural strength

* All-Union Scientific-Research Institute of Machinery and Metalworking.

falls off more rapidly and the heat exchange properties are impaired because of the disintegration of the ceramic itself and because of the deposition on the brickwork of loose furnace dust (the mechanical strength is reduced from 520 to 50 kg/cm^2, and the porosity rises from 12.5 to 33%). The specific consumption of brickwork in the regenerator brickwork up to the first hot repair, in using unfired forsterite as compared with the use of fired forsterite, increased by 27%.

The most hopeful regenerator brickwork material in conditions when oxygen is used, particularly for gas regenerators, must be considered to be periclase-forsterite bricks (with the Eastern Refractories Institute technique), which have shown positive results in trials.

With the aim of increasing the life of the individual lining elements and lengthening the service life of open-hearth furnaces between repairs, in working with the use of oxygen and compressed air the following measures should be taken:

1) The main roofs of open-hearth furnaces should not be allowed to cool below 1450-1500°C, and cold materials should not be charged into the furnace during valve change-over.

2) The duration of changing over the valves should be reduced and the fall in ten.perature during reversal should not exceed 75-100°C/min.

3) The supply of oxygen and compressed air should be organized so that the full combustion of carbon monoxide is achieved in the working volume of the furnace.

4) Unfired magnesite-chrome refractory should be used for the roofs of slag-pockets.

5) A chart of cold repairs with regard to maximum roof wear should be set up.

OPEN-HEARTH FURNACE EVAPORATIVE COOLING, WORKING AT INCREASED PRESSURE

Chief Engineer A. M. Svistunov, Chief Power Engineer

D. Ya. Deiderov

Izhevsk Metallurgical Factory
Translated from Metallurg, No.12,
pp. 17-18, 1960

In June 1960, at the Izhevsk Metallurgical Factory, an open-hearth furnace (oil-fired) went into operation with evaporative cooling, the pressure in the reservoir-separator being 12 atm.

The design of the installation working at increased pressure does not differ in principle from that of installations working at 1-3 atm which have been introduced into the majority of metallurgical factories. The beams and frames of all five charging doors were converted to evaporative cooling.

As well as the general project, the Giprostal' Institute developed two types of details to be cooled: drilled-out elements and tube elements to be cast in steel. Since the deep drilling of billets requires special machine equipment, and their preparation in other factories turns out to be expensive, the use of drilled cooling elements had to be ruled out, despite their high strength.

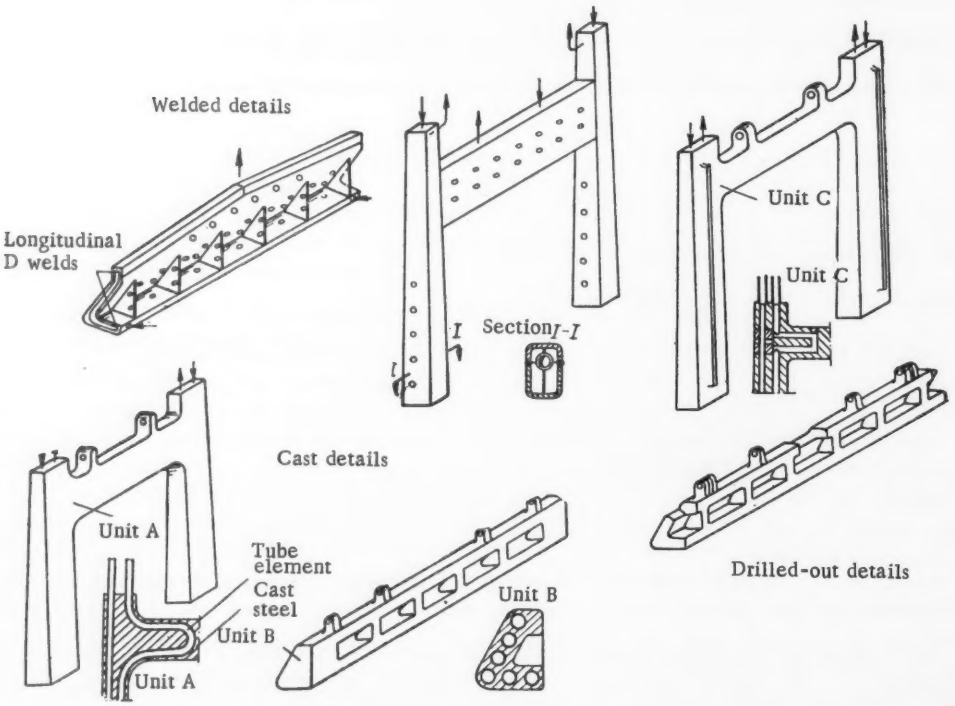
Numerous attempts to prepare cast details with tubes cast inside the castings were unsuccessful, since, during the pouring of the castings, the tube walls were burned through by the liquid steel and the straight-through section of the tubes was filled with metal. In further work, after a certain change in design, with strong cooling of the tube system during the casting process cast elements for cooling were successfully prepared. However, in use they turned out to be unreliable, since, as a result of the gradual erosion of the steel casting, the tubes were uncovered and, because of the intense local overheating, cracks and flaws appeared in them.

The planning office of the factory's power division developed stamped welded elements for cooling (figures). They were installed on the furnace in December 1959: they work reliably at a pressure of 3 atm as well as 12 atm.

The frames and base beams were made of boiler steel mark 15k, the wall thickness of the details being 14 and 18 mm. After assembling the stamped elements, straight-through anchoring connections were made into their walls, then the half-finished pieces were welded in places where they join. The longitudinal parts of the base beams were prepared by the method of mechanical working semi-finished products of high-grade rolled material (steel 20).

The frame of the charging door consists of three separate details with independent up and down tubes. The up tubes are joined into one collector. The frame elements are welded between themselves for rigidity.

The reservoir-separator, made in the factory from 14 mm steel sheet (steel 15k) has a diameter of 1215 mm. This dimension was determined by the possibility of using the ends from a boiler drum, which were in the factory. The welded joints in the reservoir-separator were tested by the gamma-defectoscope method. In conformity with the Gosgortekhnadzor inspection, the base beams were not tested, but they were prepared with especially careful control in keeping to the welding technique and with subsequent hydrostatic testing at 20 atm before mounting on the furnace.



Different designs of cooled details for evaporative cooling at 12 atm.

In the process of changing over the system to work at a pressure of 12 atm,* by experimentation it was established that the circulation in the system with the circulation pumps cut off was steady. The value of the circulation multiplicity was 30-40, which ensures that the details are well cooled. At present the system works with natural convection.

The production capacity of the installation is 3.2 tons of steam per hour. The installation works on the general heat network of the factory in parallel with the regulated production selections from TETs (Heat and

* The starting and adjustment of the system was carried out under the direction of Comrade Dakhnovich, a Giprostal' engineer.

Electric Power Plant) turbines or on the general steam distributor from the TsES (Central Electrical Power Plant) boiler. The installation is fed directly from the TsÉS supply line, situated 700 m from the open-hearth shop. This makes it possible to keep supply pumps and emergency evaporative cooling capacity in reserve.

The installation is equipped with a reduced indicator of the water level in the reservoir-separator and with a level marker, and also with a three-impulse electronic supply regulator ÉRSh, to which for the present only two impulses are connected – from the consumption of feed water and from the level in the reservoir-separator.

In changing over the remaining open-hearth furnaces of the factory to evaporative cooling at increased pressure, cooled elements of similar construction will be used: however, there will be some reduction in the number of stamped semi-finished pieces, and this will cut down the amount of work in making the elements.

Based on the first period of using the installation, the following conclusions may be made:

1. The creation of cooled elements working at increased pressure for open-hearth furnaces is successfully solved by using stamped and welded constructions.

2. Taking into account that the economic effect of changing over only one furnace to an evaporative cooling installation of increased pressure is determined as up to 500 thousand rubles, it is desirable to turn over the preparation of standardized cooled elements for open-hearth furnaces to one of the boiler-making factories, inasmuch as the type of elements used is in keeping with the technical equipment of these factories; and in the future, evaporative installations should be introduced into the field of boiler usage, which will also be prepared by boiler-making factories.

INCREASED PRODUCTIVITY OF LABOR IN OPEN-HEARTH SHOPS

P. G. Goncharov

Makeevsk Metallurgical Factory
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In recent years the collective of our factory has successfully resolved the productivity problems brought before it. In 1959 the over-all production of the factory as compared with 1958 increased by 6.6%, the output of pig-iron increased by 1.2%, the output of steel by 6.1%, the production of rolled products by 7.5%: all this was achieved only by making use of internal reserves, without increasing the number of workers or the amount of plant.

Technical and economic figures were also improved. The productivity of labor which is one of the basic figures of the state of technical progress of undertakings and is a criterion for assessing its production activity, rose 5.7% as compared with 1958.

The factory's open-hearth shops are tackling successfully with their production assignments. The average melt weight in the large-capacity furnaces has been increased by 3 tons, and rejects have been considerably reduced. The specific yield of steel from one square meter of open-hearth furnace hearth area was 7.93 tons, the average coefficient for undertakings of the Stalino sovnarkhoz (Council of National Economy) being 7.26 tons, and the average for the country being 7.48 tons. The productivity of labor in this shop rose by 6.6%.

The chief direction in the steelworkers' task is toward the reduction of time lost on open-hearth furnaces for hot and cold repairs, and the reduction of the duration of each melt. From the figures set out below it can be seen how the technical and economic details have improved in recent years, the open-hearth furnace capacities remaining constant.

	1957	1958	1959	1960
Lost furnace time in open-hearth shops	6.4	5.56	5.45	3.69
Melt duration in shops, hr-min:				
370 ton	13-05	13-03	12-33	12-41
185 ton	9-45	9-47	8-55	9-10
Specific yield of steel, tons/m^2	7.24	7.5	7.93	8.45

Furnace time lost in repairs has been systematically reduced. The average duration of melts, excluding the first quarter of 1960, has been shortened; the specific yield of steel has increased. Despite the fact that the melt duration was slightly longer in the first quarter than in the preceding year, not only did the specific yield of steel not decrease, it rose considerably.

A section of the large-capacity furnaces has gone over to the combined use of oxygen, which has given a considerable rise in production. In two small furnaces there is an injector installation operating to blow air into the gas port. Introducing this measure has made it possible to obtain a 2% increase in production and to reduce the ideal fuel consumption by 8 kg per ton of metal. Thus the saving in financial terms has been 450 thousand rubles. Thirteen steel-pouring ladles of increased capacity have been brought into operation in the open-hearth shops.

In conformity with the resolutions of the 21st Congress of the CPSU (Communist Party of the Soviet Union) in the second year of the Seven-year Plan the Makeevsk factory has to increase its production output. Steel production should increase by 5.1% as compared with 1959, and this should be accomplished also without introducing additional capacity or increasing the number of workers.

The fulfillment and over-fulfillment of the production assignments by the teams, sections, shops and by the factory as a whole in 1959 and in the first quarter of 1960, shows that there are all the resources for the successful solutions of problems placed before the collective.

The problem of the further broadening and most effective method of using oxygen in open-hearth furnaces deserves the most serious attention, as do the change-over of all open-hearth furnaces to working with the use of natural gas and the mechanization of labor-consuming tasks and the accomplishment of an automated heat regime for open-hearth furnaces.

Experience has shown that the greatest effect is given by using oxygen in the combined method of its utilization (in the bath and in the flame). In this way, melt duration is shortened by more than 30 min. At present in the factory, oxygen is used by the combined method only in individual furnaces.

As was shown by the first investigations in blowing pig-iron in the ladle with a steam-oxygen mixture after pouring it from the mixer, this measure makes it possible to shorten the melt duration by 30 min.

The introduction of natural gas into all furnaces appears to be a no less important potential source of a reduction in melt duration. This will make it possible not only to increase the specific yield of steel, but will also serve as an important factor in further reducing the cost of production.

The successful mastering of the smelting technique for alloy steels in large capacity furnaces will make it possible to convert existing 185-ton furnaces into 370-ton capacity furnaces. At present the 185-ton furnaces, situated between furnaces of larger capacity, not only reduce productivity because of their comparatively small dimensions, but also make the work of the whole shop difficult, complicating the observance of the complex regulated chart of working furnaces with the production sections connected with them. Increasing the capacity of these furnaces will give a considerable increase in the amount of steel smelted.

The mechanization and automation of labor-consuming processes in the factory in 1959 made it possible to release 121 people for use in other sections, and to make the tasks of many workers lighter. Further work in this direction will give even better results. There are other problems which urgently require solutions, such as the mechanization of repair work and the development of schemes for introducing effective means of open-hearth furnace cooling after shutting them down for cold repairs.

The problems of the mechanization of dust removal from the regenerators during the furnace campaign and the mechanization of loading and unloading work in shop warehouses also require urgent attention.

All these problems are in the center of attention of economic and trade union organizations in the factory. Their successful solution will contribute to a considerable increase in the amount of steel smelted.

Investigations of the work of front-rank teams makes it possible to draw the conclusion that their successes are explained chiefly by the extremely rational use of plant and equipment capacity and by the better organization of labor. The vigorous unity of the collective, mutual help, skill in replacing a comrade if necessary, strict observation of work and production discipline—these are the characteristic features of front-rank workers.

The teams of communist labor aim at good results in their work. In Table 1 details are shown of two teams working on the same furnace in the first quarter of 1960.

TABLE 1

Figures on the Work of Two Teams

Team	January		February		March	
	fulfillment of plan	specific yield of steel, tons/m^2	fulfillment of plan	specific yield of steel, tons/m^2	fulfillment of plan	specific yield of steel, tons/m^2
Comrade Baryshnikov's	110.8	10.36	102.1	8.99	103.6	9.36
Comrade Milovanov's	106.2	9.93	100.7	8.87	100.0	9.04

The best figures are consistently obtained by steel-worker Baryshnikov's team which was awarded the title of Team of Communist Labor. In the preceding year the specific yield of steel from each square meter of furnace hearth area in the team was 8.64 tons, which exceeds the factory average by 9.3% and the average for undertakings in the Stalino sovnarkhoz by 19%. To the personal account of the team are hundreds of tons of pig-iron and of ideal fuel saved. The productivity of labor also increases continuously. Its absolute growth in 1959 as compared with 1958 was 6.6%. In striving to raise production output the team directs its main efforts to reducing melt duration and increasing melt weight, and has achieved great successes (Table 2).

TABLE 2

Melt Duration in the Shop and in Comrade Baryshnikov's Team

Duration	Period of melt, hours-min						
	dressing	charging	heating up	pouring in pig-iron	melting	finishing	total
Average for shop.....	0–37	2–36	1–45	0–29	4–48	2–26	12–41
For Baryshnikov's team.	0–31	1–58	1–31	0–24	4–03	2–11	10–38

The saving in time in dressing is achieved by partially carrying out the pouring of the melt and the dressing of the rear wall together. The method of introducing the charge simultaneously through two doors with maximum heat loading of the furnace gives a considerable saving in time, as does pouring in the pig-iron with two pouring cranes and so on. But the combination of pouring the metal and dressing the furnace, and also introducing the charge simultaneously with two machines and pouring in the pig-iron with two cranes are possible only when the dressing materials and the tools are prepared beforehand, and the charge and pig-iron supplied in good time. Team-leader Baryshnikov does not forget to check beforehand what the position is with regard to dressing materials, what condition the tools are in, how the charge composition is arranged. He will attend to the condition of the furnace equipment, to the timely supply of slag basins, to the presence of idle staff when it is near time to pour the melt and so on.

Comrade Baryshnikov addressed a patriotic appeal to all steel workers in the Stalino sovnarkhoz – this involved the better use of open-hearth furnaces and increasing melt weight to raise the specific yield of metal by 8% in the current year.

Such an increase in the coefficient of yield of steel by all the undertakings of the Stalino sovnarkhoz will give, in addition to the plan, hundreds of thousands of tons of metal.

The implementation of technical measures and the broad extension of the practice of front rank teams among all steelworkers is a guarantee that the steel production plan in the second year of the Seven-year Plan will be successfully fulfilled.

PROBLEM OF THE CHOICE OF A METHOD FOR THE HYGIENIC CLEANING OF THE WASTE GASES FROM OPEN-HEARTH FURNACES

V. A. Gudemchik, E. M. Shabunin, Yu. V. Krasovitskii and L. A. Barkina

"Serp i Molot" Plant and NIIOGAZ*

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The successful cleaning of chimney gases at metallurgical concerns is most often made difficult by the following circumstances:

a) High degree of dispersion of furnace dust contained in the gas-dust current on entry into the chimney stack; from the results of electron microscope examination and sedimentation analysis, 96% of the dust has a particle size of less than 1.5 μ.

b) High temperature of the flue gases on entry into the chimney stack (600°-700°C in the absence of a waste-heat boiler, and up to 300°C in the presence of a boiler).

c) The considerable volume of the waste flue gases – up to 70,000 nm^3/h for a one tap-hole furnace.

d) Sharp variation in the dust content of the waste gases (from 0.3 g/nm^3 for the non-oxygen process to 3.5 g/nm^3 when the bath is oxygen blown), depending on the working conditions of the furnace, size of the bath and whether the latter is oxygen-blown.

At the "Serp i Molot" plant, an experimental apparatus was set up after one of the open-hearth furnaces, and was used for making comparative tests of three highly efficient types of dust catcher: spray tube, glass-cloth hose filter and electric precipitator, type KhR. The smoke gases were taken after the waste-heat boiler, from the furnace flue before the waste-heat boiler, when the bath was being blown with oxygen and in all the working periods of the furnace.

Figure 1 shows a general view of the spray tube and once-through cyclone, 360 mm in diameter. The spray is vertical. On its axis, at some distance from the throat is a water-spraying nozzle connected to the water supply mains. During the tests, the distance of the nozzle from the throat of the spray tube was varied from 76 to 200 mm. The diffuser of the tube was connected to the once-through cyclone. The sludge was removed through a special outlet in the lower part of the cyclone, connected to a water seal (not shown in Fig. 1). The spray tube and cyclone were made of 1Kh18N9T steel.

The glass-cloth hose filter (Fig. 2) is constructed in the form of a rectangular chamber, on the cover of which is mounted a vibrator. Inside the chamber are three glass-cloth hoses stretched on a rigid frame. The filters are suspended from a common frame connected to a rod, which in its turn is fixed to the vibrating frame. An electric heater is mounted in the lower part of the chamber under the filters.

* State Scientific Research Institute of Gas Purification for Industry and Sanitation.

TABLE 1
Average Data for Spray-Tube Operation

Heat period	Dust content g/nm³		Cleaning efficiency, %	Resistance, kg/mm²		Gas temperature in gas passage		Rate of flow of gas nm³/h
	inlet	outlet		tube	cyclone	inlet	outlet	
Charging	0,309	0,149	52,0	179—380	—	135—250	49—77	1220
Meeting	0,374	0,153	59,0		—			1130
Boil	0,264	0,127	52,0		—			1120
Average data	0,316	0,143	55	265	13	220	59	

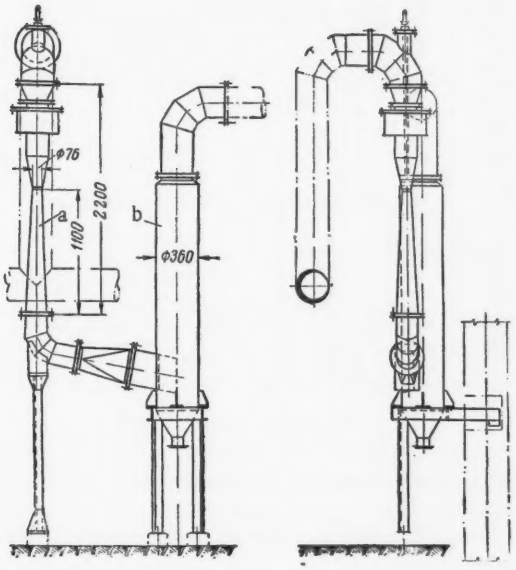


Fig. 1. General view of assembly of spray tube (a) and once-through cyclone (b).

The tubular electric precipitator type KhR, usually employed for the fine cleaning of high-temperature gases from dust (Fig. 3), consists of two consecutively situated sections, each of which is a bundle of 20 parallel tubes, 250 mm in diameter and 3000 mm in height. The lower chambers of the sections are connected together and the upper chambers are separated by a closed partition. The inlet is connected to the upper chamber of the first section and the outlet to the upper chamber of the second section. The tubes act as precipitation electrodes. Inside the tubes are corona-discharge leads suspended from a common frame. The dust is shaken off automatically from the corona discharge electrodes and manually from the precipitation electrodes.

The electric filter is fed off a step-up rectifying unit of type AFA-90-200.

The results of the tests of the different types of dust catcher are discussed below. As will be seen from Table 1, the maximum value of efficiency of the spray tube (59%) was obtained in the melt-down period, corresponding to the maximum dust content of the waste gases. The mean efficiency was 55%. The variation in the resistance of the spray tube was obtained by varying the rate of flow of the gas and the water spraying the gas. It should be noted that by variation of the resistance from 150 to 380 kg/m², the efficiency was increased 36 to 65%.

The results of the tests on the filter showed that the specific gas load on the cloth varied from 0.74 to 0.89 $m^3/m^2 \cdot min$. The dust-catching efficiency was practically not less than 99.0%. When the resistance of the apparatus attained 138 kg/m², an attempt was made to remove the dust settled on the cloth by vibration. Due to the high degree of dispersion of the dust, however, the latter was not shaken off. Replacement of the vibratory shaking by tapping did not appreciably reduce the resistance of the filter. The tests made thus show that it is impossible to remove the dust which settles on cloth and so ensure reliable operation of the apparatus. For this reason, no further tests were made with the glass-cloth hose filter.

Investigations made during the tests on the electric precipitator showed that the efficiency of gas-cleaning depended on the velocity and pressure of the gas in the tubes, the current density, temperature of the gas and some other factors.

On testing the atomizer tube for gas cleaning in front of a waste-heat boiler (the gas was taken from the furnace flue), there was an abrupt drop in temperature of the cleaned gas by 400-500°C. This in itself eliminates the possibility of using the atomizer tube for cleaning flue gases in front of waste-heat boilers. Variation in the position of

the nozzle in the atomizing tube and in the position in which the gases were taken (in front of or after the waste-heat boiler) had no effect on the degree of cleaning.

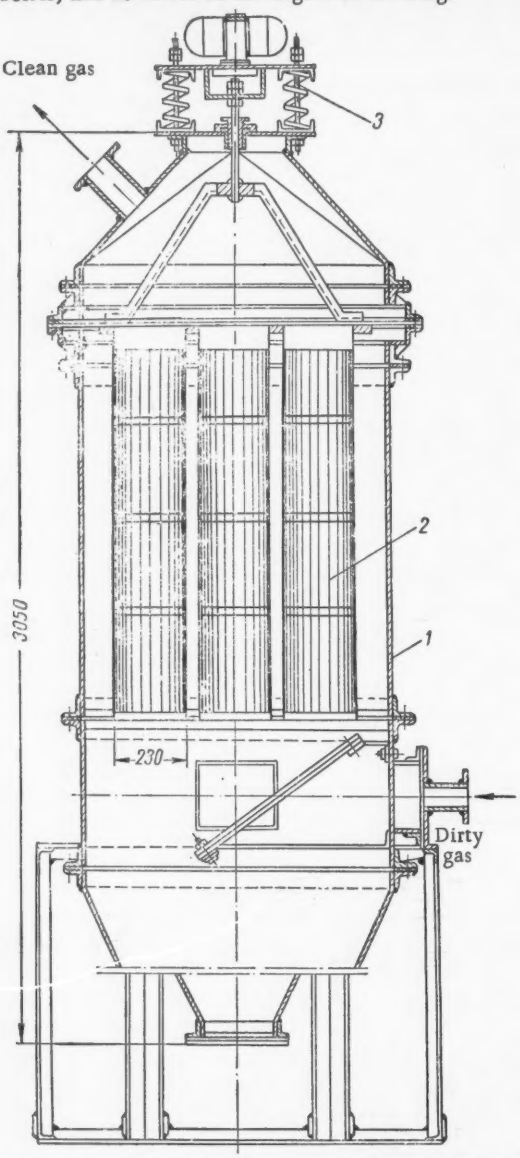


Fig. 2. Glass-cloth hose filter with vibratory shaking: 1) Casing; 2) glass-cloth filter element (hose); 3) vibrating device.

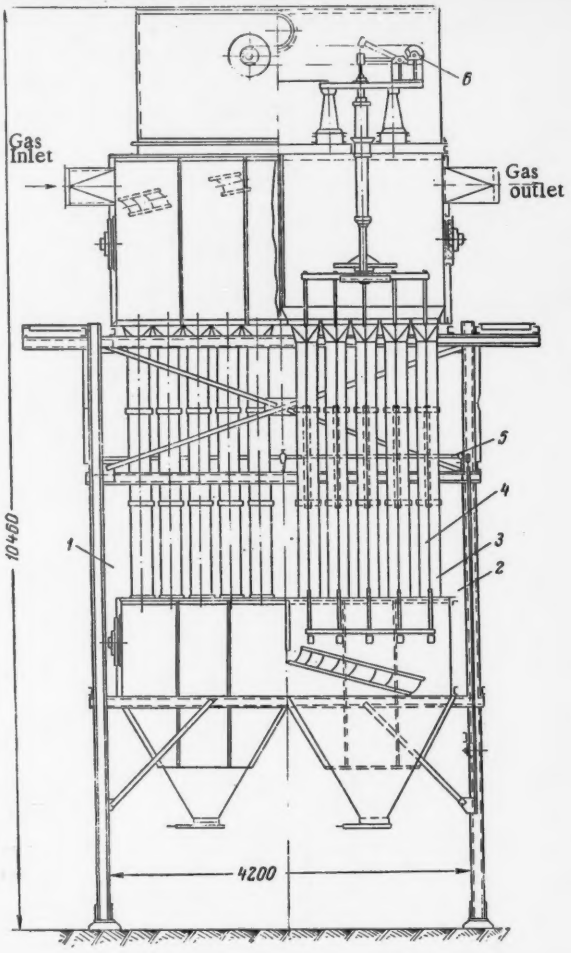


Fig. 3. Electric precipitator type KhR: 1) First section; 2) second section; 3) precipitation electrodes; 4) corona-discharge electrodes; 5) mechanism for shaking the precipitation electrodes; 6) mechanism for shaking the corona-discharge electrodes.

The tests showed that with a velocity of gas in the tubes not exceeding 1.6m/sec, the residual dust content does not exceed 0.001 g/nm^3. When the velocity is increased, the residual dust content is increased somewhat, and at a velocity of gas in the tubes of 1.85 m/sec there is a break, after which a slight increase in velocity produces a sharp increase in residual dust content, i.e., in a reduction in dust-catching efficiency. When the velocity of the gas is varied from 1.5 to 2 m/sec, the dust-catching efficiency is reduced from 99.8 to 95%.

For a gas velocity in the tubes of 2 m/sec, the resistance of the electric precipitator does not exceed 30 kg/m^2. No substantial change in dust-catching efficiency is found when the inlet temperature of the gas is varied from 200° to 388°C. It should be observed that the first section of the electric precipitator catches more than 88% and the second less than 7%. Tests show that even at a current density* of 0.6 ma/m, the gas-cleaning efficiency attains 98.8%, the residual dust content not exceeding 0.005 g/nm^3.

*In the electric precipitator, it is customary to refer the current strength to meter length of the corona discharge electrode. This quantity is called current density.

TABLE 2

Results of Tests on Electric Precipitator

Heat Period	Rate of flow of gas nm^3/hr	Gas velocity m/sec		Resistance kg/m^2	Temperature, °C		Dust content g/nm^3		Degree of cleaning %
		1st section	2nd section		inlet in 1st section	Outlet from 2nd section	inlet in 1st section	Outlet from 2nd section	
Charging	1850	1,16	0,98	14	231	79	0,166	0,0023	99,2
Charging	1830	1,09	0,92	14	235	79	0,102	0,0023	98,7
Charging	1400	1,49	1,18	24	294	88	0,168	0,00105	99,3
Melting	2180	1,26	1,15	23	261	75	0,396	0,00684	98,9
Melting	1836	1,19	0,97	15	259	87	0,342	0,0034	98,7
Melting	1885	1,16	0,99	20	250	91	0,353	0,0044	98,9
Melting	1840	1,12	0,95	14	236	86	0,108	0,00341	—
Boil	1860	1,07	0,93	17	210	63	0,108	0,0032	97,5
Boil	1860	1,08	0,92	10	210	73	0,342	0,00306	97,55
Boil	1885	1,16	0,99	20	250	91	0,120	0,0044	98,7
Boil	2330	1,43	1,02	23	237	95	0,120	0,00175	98,5

The results of the tests of the electric precipitator for different working periods of the furnace are shown in Table 2.

In the course of the experiments, it was found that periodic shaking of the precipitation and corona-discharge electrodes every 60 min did not disturb the stability of operation of the electric precipitator. The following optimum working conditions of the electric precipitator were found:

Velocity of gas in tubes, m/sec	1.8
Inlet-temperature of gas, °C	up to 380
Shaking period of corona-discharge and precipitation electrodes, min	60
Current density, ma/m	0.6

In these conditions, the electric precipitator ensures a degree of cleaning of not less than 97%. It should be borne in mine that in the experimental apparatus, considerable cooling of the precipitation tubes was observed, resulting in pronounced inequality of operation of the two consecutive sections. In an industrial apparatus, a more regular relation between the efficiencies of the consecutive sections of the electric precipitator would be expected.

From a comparison of the efficiency and working reliability of the three types of apparatus it may be concluded that the electric precipitator is the most acceptable for the hygienic cleaning of the waste gases of open-hearth furnaces. From experimental and published data, the consumption of electric power for the operation of electric precipitators does not exceed 0.3 kw-hr per 100 m^3 of gas.

The Institute NIIOGAZ and the "Serp i Molot" plant have submitted original data for the design of an industrial installation for cleaning the waste gases of open-hearth furnaces.

Taking into consideration the fact that hygienic cleaning is only a partial solution of the general problem of the removal of dust from waste chimney gases, the plant is carrying out work on the investigation of the fundamental bases of industrial gas-cleaning with a view to protecting from dust deposits the heat-exchange surfaces situated in the furnace circuit, and thus increasing the power efficiency of the operation of the entire steel-melting aggregate.

ROLLING SQUARES WITH HIGH-QUALITY CORNERS

M. A. Volovel'skii

Komintem Dnepropetrovsk Metallurgical Plant
Translated from Metallurg, No.12,
pp. 24-25, 1960

Squares with cross sections of 12 × 12 mm, 14 × 14 mm, and 16 × 16 mm are rolled on the 260-merchant mill of our plant. The finishing train of the mill consists of seven stands of two-high reversing mills in train. The number of revolutions of the rolls of the finishing train is regulated, their average peripheral speed while rolling squares is 6 m/sec.

The squares are rolled in the mill in five passes according to the diamond-square system with two intermediate diamonds (Fig. 1).

However, whereas rolling of a square manually does not present difficulties in the sense of obtaining a finished square with well-made side corners, when rolling on a mill equipped with guide apparatus it is somewhat more difficult to obtain a finished square with high-quality corners.

In practice poorly made corners on a square occurs both along the entire length and at individual sections of it.

When rolling with guide apparatus the planishing square is of primary importance for obtaining high-quality corners on the square. When working with the apparatus, the position of the planishing square is unsteady in the diamond groove, the square tends to turn from an "on edge" position to "flatwise." Therefore at those places where the square bloom is rooled in the planishing diamond groove "flatwise," the obtuse angles of the diamond bloom are unfilled (Fig. 2). When feeding such a bloom into the finishing groove the right angles of the square were deformed and a considerable amount of the metal became second grade.

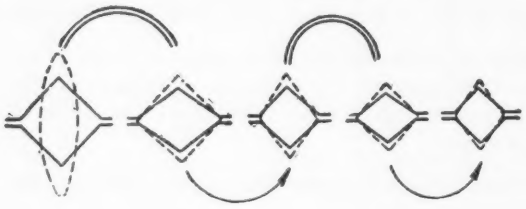


Fig. 1. Diagram of rolling steel squares.

Attempts to produce high-quality corners along the entire length of the finishing section from the planishing square, all sides of which are equidimensional, have been unsuccessful: the position of the planishing square in the diamond groove remained unsteady.

In order to prevent rounding of the planishing square and to develop steadiness in the diamond groove the upper roll was shifted relative to the lower roll toward the side opposite to the rolling directions. In this case the position of the planishing square in the diamond groove became steady. Moreover, even the certain unfilling of the side corners of the planishing square did not tell on the finishing section since the side corners of the square always entered the angles at the vertices of the diamond groove, and the well-made angles at the vertices of the square became side corners of the diamond (Fig.3).

Thus due to the certain shift of the upper roll of the planishing square a standard planishing diamond is attained, which in turn makes it possible to produce high-quality corners of the squares.

In practice, within the range of cross sections of squares rolled on the mill, a good result is obtained from a planishing square with a difference of the large and small side of

$$C_{lg} - C_{sm} = 0.4 - 0.8\,\text{mm}$$

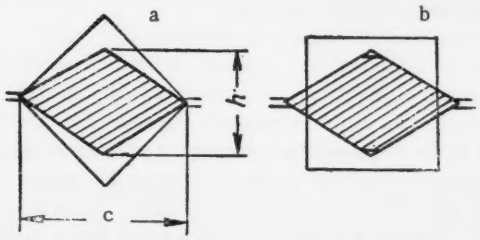


Fig. 2. Position of square in diamond groove: a) Correct; b) incorrect.

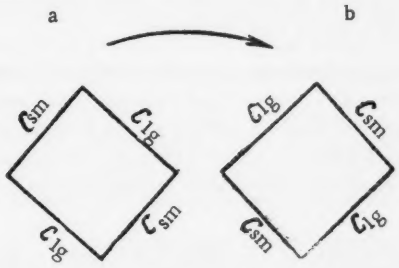


Fig. 3. Position of the planishing square: a) after leaving the square groove; b) when entering the diamond groove.

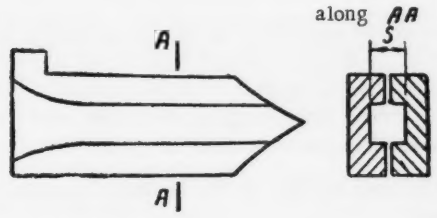


Fig. 4. Pass for directing the square bloom into the diamond groove.

For a practical calculation of the sides of the planishing square we can use the equations

$$C_{sm} = 1.175\,C_x$$

and

$$C_{lg} = 1.175\,C_x + (0.4 - 0.8)\text{mm},$$

where C_x is the side of the square in the cold state; $(0.4 - 0.8)$ is the difference of the sides of the planishing square for squares of smaller and larger dimensions respectively.

The dimensions of the planishing diamond are determined relative to the dimensions of the planishing square.

The thickness of the diamond:

$$h = C_{sm} = 1.175 \cdot C_x;\ b = 1.41 \cdot C_{sm} = 1.41 \cdot 1.175 \cdot C_x.$$

We note that the relation of the width of the diamond to its thickness for all dimensions of the square is constant:

$$\frac{b}{h} = 1.41.$$

These equations are applicable for soft steels; in the case of rolling hard steel the sizes of the intermediate squares and diamonds, including the planishing, are somewhat reduced by the usual adjustment of the mill.

In order to direct the planishing square bloom into the diamond groove and to hold it in the groove in an "on edge" position we used a pair of passes with smooth grooves (Fig. 4). The width of the passes S at the entrance to the diamond groove is determined from the equation:

$$S = \frac{C_{sm} + C_{lg}}{2} \cdot 1.41.$$

Rolling of squares whose planishing squares and diamonds were calculated by the equations noted above made it possible to produce high-quality corners on the squares and thus completely eliminate second-grade production due to poorly made corners.

OPERATION OF REGENERATIVE PITS OF A BLOOMING MILL WITH LIQUID SLAG REMOVAL

I. I. Sterlikov

Foreman of the Blooming Mill Pit of the Magnitogorsk Metallurgical Combine

Translated from Metallurg, No.12,
pp. 26-28, 1960

When designing the soaking pits of the blooming mill at the Magnitogorsk Metallurgical Combine, the State All-Union Design and Planning Institute of the Ministry of Ferrous Metallurgy eliminated the present shortcomings in the active regenerative soaking pits of the blooming mills which had been constructed earlier. Butterfly valves of the "Forter" and "Simplex" system were designed properly for each chamber and chamber flue gate valves were provided. Thus, each chamber became an independent unit. In addition to this the capacity of the chamber was increased 25% as against that of the regenerative pits which existed.

The framework and working platforms of the groups of pits proved to operate well. After nineteen years of operation the framework and working platforms of the groups of pits are in good condition.

In spite of the positive aspects, serious shortcomings were nevertheless present in the design of the new blooming mill. For example, the slag is removed from the bottoms in a dry form and by hand, which requires much time and heavy physical labor. Much capital was spent on coke fines for fettling the pit bottoms and for its railway transportation. The chamber gate valve was raised on a cable by a hand winch and this hampered the pit operators' work of regulating the pressure in each individual chamber. There were serious faults in the refractory bricking of the pits.

The absence of an automatic heating machine, the limited number of measuring instruments, as well as the shortcomings stated above —all this had an adverse effect on the quality of heating the metal and on the economic indices of pit operation.

At the present time the pits of the blooming mill are continuously being improved by the forces of the shop and combine. In particular, liquid slag removal with periodic emptying of the slag every 8-10 charges is being utilized.

The slag is removed simultaneously from two adjacent chambers connected together by an opening in the wall that divides both chambers. During one slagging off, 0.75 m^3 of slag is removed from the 18 m^2 bottoms of the two adjacent chambers. The duration of heating the compartments together with the removal of the slag from the two chambers is 45-75 min. The temperature in the chambers during slagging off reaches 1400-1460°. While heating the metal, about another 20% of the slag is removed from the bottoms of the pits.

From the slag corridor the slag is transported by cars to the scrap section. By this method of removal the need to use the tong cranes of the pits is completely eliminated.

The removal of slag as liquid eliminates heavy physical labor, considerably increases the productivity of the pits by decreasing the time of heating the metal, and cuts back the staff of pit operators. The expenditures for coke fines, which went for fettling the pit bottoms were completely eliminated. This saves 2,000,000 rubles per year. The consumption of fuel and refractory bricks was reduced, the quality of heating the metal improved, it became possible to use the weld slag of the pits in blast-furnace production.

Still better is the method of removing slag that was introduced at the Kuznetsk Metallurgical Combine, where the slag is removed from the pit bottoms during heating of the metal. This is a very important factor for increasing the productivity of pits. In the pits of the Kuznetsk Metallurgical Combine, 90% of the ingots, which widen upwards, are heated, which makes for good heating of the bottom and produces excellent conditions for slagging off while heating the metal. A ceramic lining remains on the head section of the ingot which widens upwards after stripping and, falling along with the liquid scale to the bottom of the pits, reduces the melting temperature of the slag. Little cold metal is put into the pits of the Kuznetsk Metallurgical Combine, and the hot metal is put in at a greater temperature than at other plants. This also favors liquid slagging off during heating.

In order to assure removal of the slag during heating of the metal it is necessary to keep the gas checkers in good condition. The men of Kuznetsk change them yearly, while at the Magnitogorsk Metallurgical Combine the gas checkers are changed only after 2.5-3 years and the air checkers after 5-6 years.

However, such conditions, as at the Kuznetsk Combine, for removing slag during heating of metal cannot be created at the pits of the blooming mills at the Magnitogorsk Metallurgical Combine.

First, it is impossible to change the configuration of the ingots since it is determined by the products turned out by each combine. Second, it is impossible to replace the lined cast-iron molds with ceramic which are used at the Kuznetsk Metallurgical Combine since this is associated with the introduction of new technology for the shop that prepares the compositions at the Magnitogorsk Metallurgical Combine. Third, it is impossible to reduce the delivery of cold ingots to the pits.

Investigations carried out by the workers of the Central Factory Laboratory and the shop showed that it is impossible to obtain the same effect from the special fluxes introduced to the pit bottoms as from the ceramic linings used at the Kuznetsk Metallurgical Combine, in spite of their similar chemical composition. This canbe explained by the good mixing of the fragments of the refractory material and the scale, which thus creates a good chemical reaction between them.

In addition to this, fettling of the bottoms with fluxes is a labor-consuming process and after it is done a certain time is needed for heating the bottoms and pits. Also, in the chambers fettled by fluxes the bottom of the ingot is heated poorly and consequently a greater time is needed to heat the ingot.

In order to decrease the resistance along the path of the combustion products the group gate valves were removed since the chamber valves are completely sufficient to regulate the pressure or exhaustion in the pits: swivel butterfly valves began to be used; the valves raised by a cable to a vertical position were rejected due to their inertness. The valves operate from an electric motor and are automated in certain groups.

Due to the improvement in the technology of heating metal the temperature in the zone of the flue valves was lowered which made it possible to keep from cooling them with water. Practice has shown that during the course of several years no damage to the valves has been observed since the temperature of the combustion products was low.

The use of an automatic heating unit has had a positive effect on the operation of the pits.

The opinion exists that regenerative pits cannot be equipped with an automatic heating unit. Practice shows otherwise. The use of an automatic heating unit has improved the heating of ingots both with respect to height and to cross section. Overheating and loss of metal have been reduced, and the heating time of the metal shortened; maintenance of the pits was facilitated—one pit operator works on three groups of eight-place pits; with the norm per shift being 1060 t of heated metal, a pit operator can produce to 1400 t during some shifts.

Ingots are heated unevenly in regenerative pits: the ingots located nearest the checkerwork are usually fused and the middle ingots poorly heated. This situation is justified for regenerative pits not equipped with an automatic heating unit.

With the introduction of an automatic heating unit the unevenness of heating the ingots due to the temperature shifts of the regenerators' checkerwork disappeared. With the existing automatic heating units the pit operator can eliminate the temperature shift of the regenerators' checkerwork by means of a time relay by setting a longer interval of time for the entrance of gas and air from the hotter side of the checkerworks. This setting can be changed after eliminating the temperature shift in the checkerwork of the regenerators.

An increase in the entrance of gas and air leads to a more rapid cooling of the overheated checkerwork of the regenerators and, as a consequence of the increased consumption of fuel and air, a large amount of combustion products is formed which accelerates an increase in temperature of the cold checkerworks of the regenerators on the opposite side.

A shorter period for the entrance of gas and air is set from the side of the cooler checkerworks of the regenerators and thus the temperature shift is stopped. If the pit operator does not take measures to eliminate it during the first period of heating (as is usually encountered in practice) the automatic heating unit itself from the instant of reaching the given temperature for the soaking period eliminates the temperature shift. This is achieved in the

following manner: a switching of the radiation pyrometers is provided at each transfer point in the valve tripping circuit; as a consequence of this the temperature is always measured on the side of the out-going combustion products, i.e., on the hottest side.

If the near side of the regenerators' checkers is overheated and the temperature on the far side is considerably lower, then as soon as the given temperature of the ingots is reached on the near side the control mechanism receives the command to reduce the expenditure of gas and air.

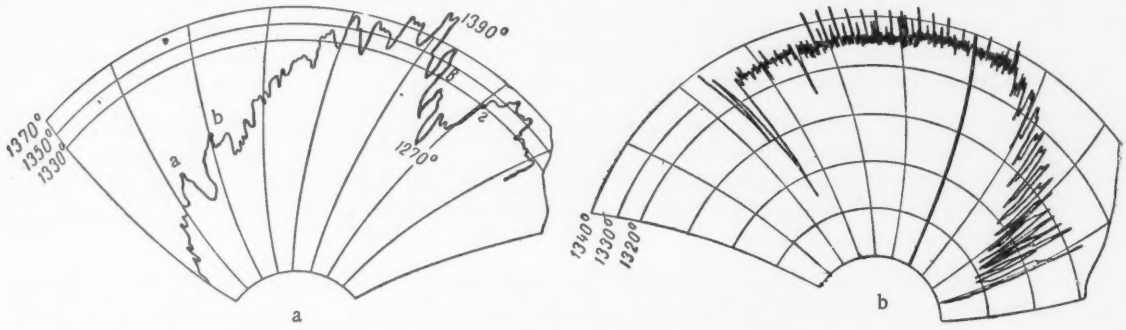


Fig. 1. Diagram of heating cold-delivered ingots: a) With manual control of the heat regime (heating time 7 hr 15 min); b) with automatic control of the heating regime (heating time 6 hr 20 min).

As soon as the expenditure of gas and air is reduced, the checkers of the regenerators on the far side, which by this time have a lower temperature, begin to be cooled less. Simultaneously the conditions for a further heating of the checkers on the near side disappear since fewer combustion products will pass through these checkers.

When the valves trip the gas and air will pass from the hotter side of the regenerators' checkers and the temperature is measured by the radiation pyrometer from the cooler side of the checkerworks. The control mechanism receives the command to increase the expenditure of gas and air, which creates conditions for a more rapid cooling of the overheated checkerworks and an increase in the temperature of the cooler checkerworks.

Consequently, due to the technically skillful circuit of switching over the radiation pyrometers, the temperature shift of the regenerators' checkers is eliminated by the automatic heating unit itself at the instant the temperature of the metal reaches that set by the pit operator. In this manner this circuit favors quality heating of the metal and eliminates premature wear of the regenerators' checkers from high-temperature shifts. Experience has shown that with the existing automatic heating units the checkers for gas operate for 2.5-3 years and those for air to 5-6 years.

Figure 1 shows the diagrams of heating cold-delivered metal with manual and automatic control. As is apparent from Fig. 1, automation of the heating regime makes it possible to cut back the heating time by 55 min.

It is almost impossible to maintain the given temperature of the metal with manual control and large temperature drops are inevitable, which decreases the quality of heating the metal, leads to an overconsumption of fuel and to the increased loss of metal.

Thus, for example, with manual control the temperature of the metal reached 1390°, which is considerably higher than the temperature for melting the scale from the ingots. The pit operator was forced to reduce sharply the temperature to 1270° to stop melting of the scale.

The automatic heating unit helps to reduce considerably the fusion of ingots and helps to make their heating uniform.

Investigations were carried out to determine the temperature distribution when heating ingots of cold-delivered rimming steel weighing 7.1 tons. It is apparent from Fig. 2 that the given temperature for the period of soaking-holding is reached about 4 hr after delivery of the ingots. The entire remaining time that the metal was in the pits was the period of soaking.

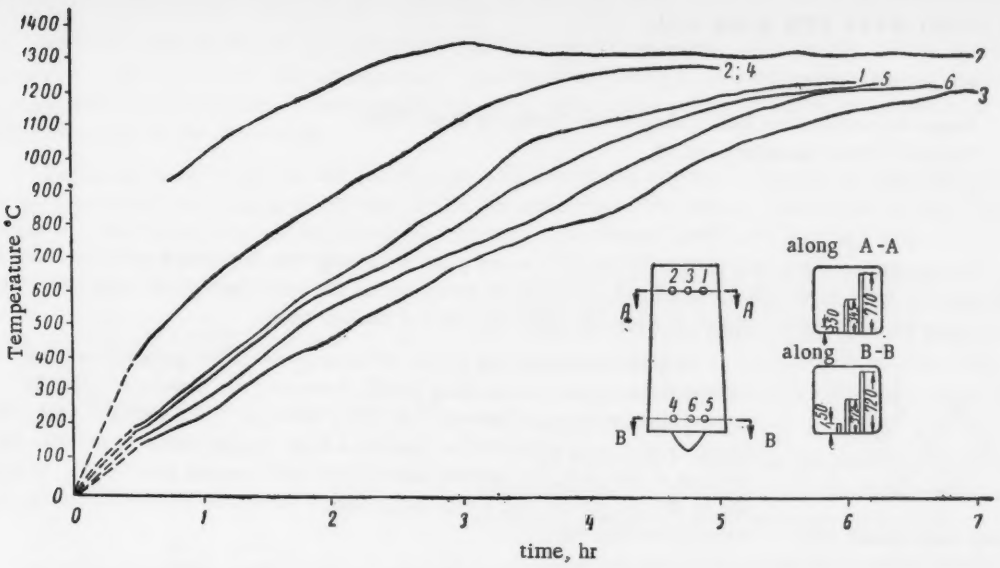


Fig. 2. Distribution of temperatures in an ingot of cold-delivered rimming steel (potentiometer readings): 1-6) Temperature at different points of the ingot; 7) ingot temperature according to the electron potentiometer.

The lengthy soaking period creates conditions for uniform heating of the ingots. Curves 2 and 4 coincided which indicates a good uniformity of ingot heating with respect to the height of the side turned toward the wall of the chamber. Curves 1 and 5 also indicate a uniformity of ingot heating with respect to the height of the side facing inside the opening. Curves 3 and 6 show a good heating in the center relative to the height of the ingot. The temperature in the center of the ingot is, of course, lower than on its surface.

Consequently, the statement of certain specialists concerning the great unevenness of ingot heating in regenerative pits refers to pits constructed under the first and second Five-Year Plans. In regenerative pits equipped with an automatic heating unit with electronic instruments, a good uniformity of ingot heating is attained.

After the introduction of an automatic heating unit, the daily output of a single group of pits of blooming mill No. 3 with delivery of hot ingots having a temperature of 780°C and of 10% cold ingots is 1000 t.

The consumption of fuel per ton of input is given below:

	1957	1958	1959
Actual fuel consumption, kg/t	34.5	35.3	36.3
Amount of cold ingots, %	5.9	7.5	10.0
Average delivery temperature of metal, °C .	790	790	778

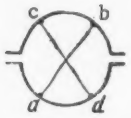
The productivity of the regenerative pits can be increased by a greater number of delivery sites and by the installation of an additional automatic unit, for example, optimizing regulators for selecting the best ratio of gas with air and for producing the given temperature.

FINISHING PASS FOR WIRE ROD

A. T. Bykadorov

Senior-Foreman of the Rolling shop of the "Krasnaya Etna" Plant
Translated from Metallurg, No.12,
p. 29, 1960

The dimensions of wire rod on the 270-rod mill at our plant for a long time has considerably exceeded the allowances of ± 0.5 mm for ordinary steel and ± 0.4 mm for spring steel. The main fault of the wire rod being produced was the considerable degree of ovalness which reached 1.0 mm and more.



Sections where passes wear.

In order to improve the profile of the wire rod it was proposed to change the roll-groove design of the finishing stand. Previously the grooves were cut by a single plug (for example, for wire rod with a diameter of 6.5 mm by a plug with a diameter of 7 mm), which did not provide a high-quality profile of the wire rod. Sections at sites a-b, c-d quickly wore out in such a groove (see figure). In addition to this the groove had a very large margin for expansion, which affected the shape of the wire rod.

At present the grooves in the rolls of the finishing stand for wire rod of 6.5-8 mm diameter are cut by means of two plugs, the dimensions of which are given below in mm:

Diameter of wire rod	6.5	7.0	8.0
Diameter of plug	6.5; 7.1	7.0; 7.6	8.0; 8.6

Such a method of cutting the grooves on the rolls made it possible to create a more efficient finishing pass for wire rod. The accuracy of the profile when rolling in the finishing pass is also affected by the size of the gap between the rolls, especially on mills having cast-iron mounts and blocks, and therefore the gap between the rolls was reduced from 1.2 to 0.8 mm.

The use of the new finishing pass for wire rod on the 270-wire-rolling mill allowed us to cut in half the number of seconds due to their "geometry."

RECONSTRUCTION OF THE MOVABLE STOPPERS

V. G. Attaryan

Zakavkazskii Metallurgical Plant
Translated from Metallurg, No. 12,
p. 30, 1960

On the 900-tube-billet mill of our plant the 90-280-mm diameter billet is cut by two movable and two stationary saws. The square billet, 75 × 75 and 100 × 100 mm, is cut on hot-cutting shears at a pressure of 250 t.

In order to stop the moving billet behind the saws and shears there are movable stops designed by the Novo-Kramatorskii Heavy Machinery Plant with a travel length at the movable saws and at the shears of 6 m and at the stationary saws of 2.2 m.

The maximum weight of the billet is 5 t with a roll table speed of 2 m/sec. The stop is moved by a lead screw and is lowered through a system of levers and a square shaft by a pneumatic cylinder installed on the main support pedestal of the stop (Fig. 1).

When the mill was started up it turned out that the stops did not operate satisfactorily, did not assure a standard cut and output: they moved very slowly, were frequently wedged, whereby movement was possible only in a lowered position; therefore it was impossible to move them during cutting or during transportation of the billet for setting up the next length.

Due to the heavy overloads, the electric motor for moving the stop was frequently put out of operation and the pi-shaped cast iron housings of the bearings for the square shaft were broken. Substitution of steel housings for the cast iron housings did not eliminate the breakage. The planned speed and lift height were not provided.

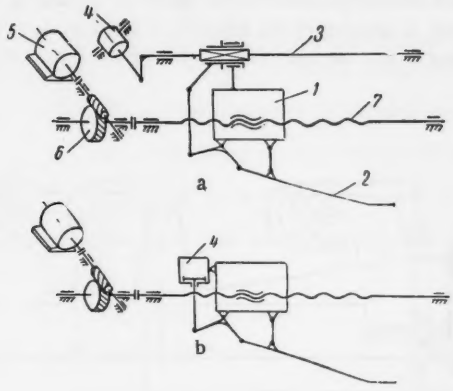


Fig. 1. Schematic diagram of the movable stop: a) Before reconstruction; b) after reconstruction; 1) Carriage; 2) stop; 3) square shaft; 4) cylinder; 5) electric motor; 6) reducing gear; 7) lead screw.

All this led to the fact that the stops were little used and the billets were arrested without stops by the shoving and hauling of the saw operators on command from the cutters. Therefore the roll tables with an individual drive at the saws underwent frequent reverse loads, which was one the main causes for breakage of the shaft necks of the roll tables' electric motors.

On the author's suggestion the movable stops were reconstructed and this completely eliminated the indicated shortcomings and assured normal operation of the mill.

The square shaft with levers and bearing housings were dismantled and a pneumatic cylinder was installed directly on the carriage. The cylinder was installed on a special welded bracket fastened on the main bearing housing of the square shaft on the carriage. Air was fed to the cylinder by an air hose.

The construction of the piston packing of the pneumatic cylinder was also changed: the hard-to-get leather cup packs were replaced by rubberized rings made from the conveyer belt, having a thickness of 16-18 mm (Fig. 2). In the piston assembly the rubberized rings are made with a diameter 0.5% greater than the diameter of the cylinder. The air cylinder with such rings operates completely satisfactorily. Their service life is 10-12 months. The unit for moving the stop remained unchanged.

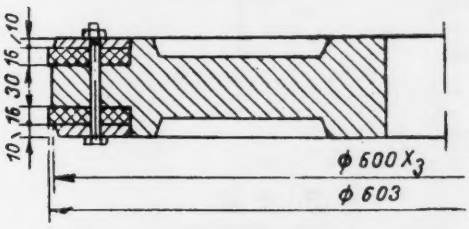


Fig. 2. Piston with a ring made from the conveyer belt.

After reconstruction the stops were easily moved both in the lowered position and in the unraised position at the planned speed of 2.6 m/min. As a consequence of the change of the relationship of the lengths of the levers, the force on the driven lever was increased by 30%, therefore, the speed was increased and the planned lift-height of the stop attained.

After reconstruction the metal was cut only with the aid of the stops which assures the necessary output; reversing of the roll tables at the saw ceased, which reduced breakage of the shaft necks of the electric motors for the roll tables.

The weight of the movable stops was reduced by 14.95 t including the weight of the bronze parts by 1152 kg.

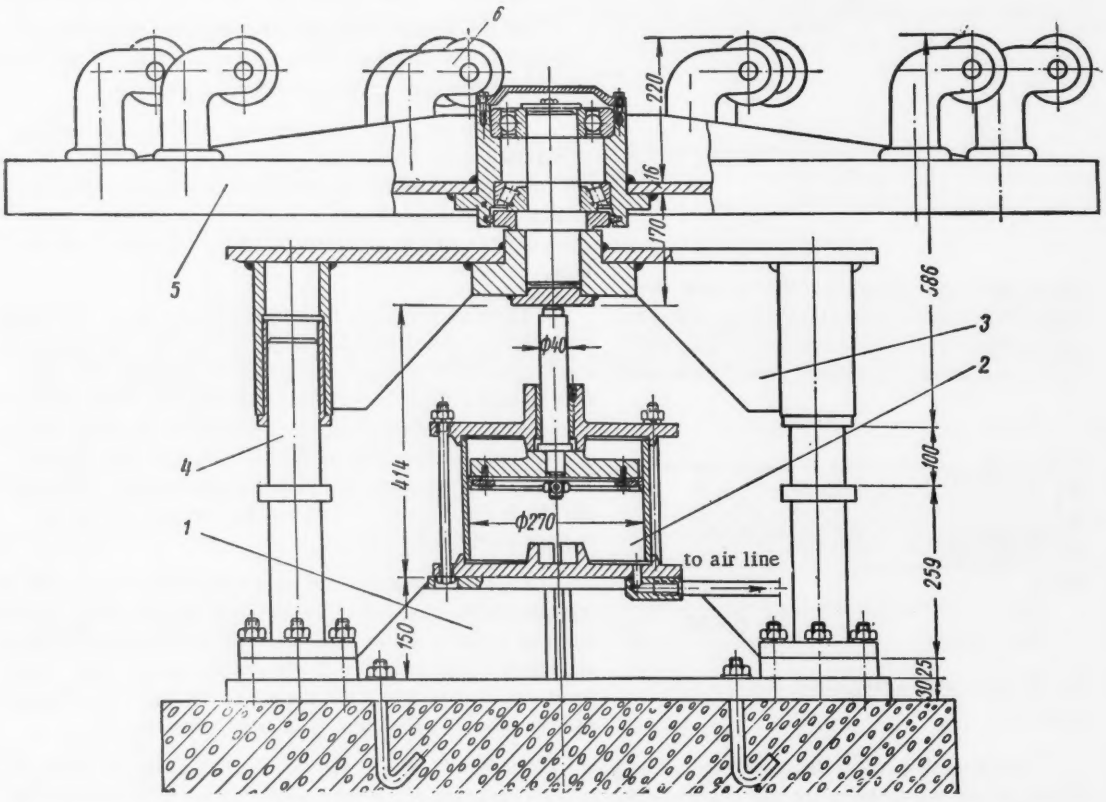
At the present time movable stops are being designed by the Novo-Kramatorskii Machine Plant, taking into consideration the remodeling that has been made for reconstruction of the tube-billet mill.

A LIFT-TURNTABLE FOR THE GUILLOTINE SHEARS

F. V. Palaguta

A. A. Zhdanov Izhorskii Plant
Translated from Metallurg, No.12,
p. 31, 1960

In order to facilitate the labor of the cutters and to relieve the bridge crane of the operation of turning the sheets on the goose-neck area during their cutting, M. N. Pisarev, a designer of the Izhorskii Plant, together with the author designed a pneumatic lift-turntable (figure), coupling it into the roll table of the "goose necks" at the shears.



Lift-turntable: 1) Lower frame; 2) pneumatic lift; 3) upper frame; 4) guide column; 5) turntable; 6) "goose necks."

As the sheet moves the lift table is lowered and its "goose necks" are at the same level with the "goose necks" at the shears. When the sheet must be turned for trimming, it is delivered to the table, the air is switched on, and the table together with the sheet is raised. In this position the table is turned, the air cut off, the table is lowered, and the sheet is fed under the shears.

After trimming one side the operation is repeated.

The introduction of this device increased labor productivity 10% and facilitated the labor of the cutters.

MANUFACTURE OF CIRCULAR BLADES FOR HOT-CUTTING SAWS

V. V. Tatarnikov

"Azovstal'" Plant
Translated from Metallurg No.12,
pp. 32-33, 1960

The technology of manufacturing a new circular blade consists of the following:

a) Cutting out around the outside diameter and preliminary boring of the inside opening for fitting on the working shaft (on a turning and boring lathe) in each blade;

b) Final boring of the holes of the pack and subsequent drilling of the fastening holes with respect to the jig;

c) Assembling a pack of 15-20 blades for notching and fastening it with special washers by means of bolts;

d) Notching the teeth of the blades on a tooth-cutting mill;

e) Disassembling the pack after notching the teeth of the blades and trimming the burrs on the teeth (with a file);

f) Straightening the blades;

g) Balancing the blades;

h) Hardening the teeth by means of electric contact heating.

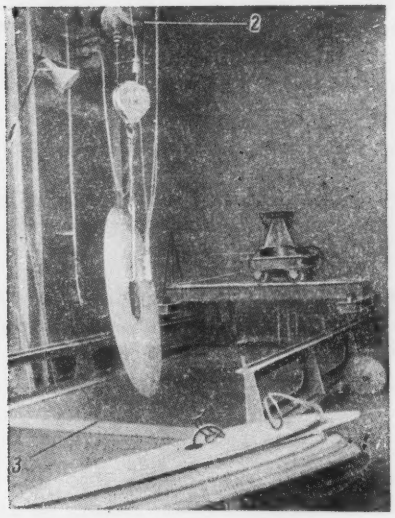


Fig. 1. Device for delivering the blades to the straightening plate: 1) Swivel arm; 2) telpher line; 3) straightening plate.

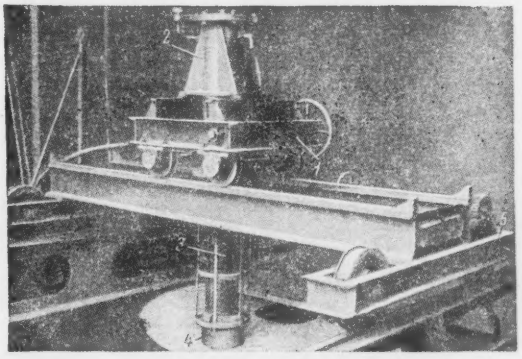


Fig. 2. Device for automatic straightening of blades: 1 and 5) Upper and lower carriages; 2) pneumatic cylinder; 3) rod; 4) hammer head.

At our plant lever saws (blade is 1210 mm in diameter, 6.5 mm thick) are straightened by hand and slide saws (1525 and 1800 mm in diameter, 10 mm thick) are straightened on a special air hammer (Figs. 1 and 2). Straightening is accomplished in a special manner. On a swivel arm located over the air hammer stand is mounted a telpher line designed to deliver the blades to the straightening plate and to remove them after straightening. On the upper carriage of the straightening device is a pneumatic cylinder fastened vertically, the rod of which when it drops as a hammer head strikes the blade and thus straightens it. In order to strike along the entire plane of the circular saw blade, both carriages move horizontally in two mutually perpendicular directions. They are moved manually. The lower carriage moves along rails of the support beams set on the floor of the straightening department, and the upper carriage along rails fastened on the

framework of the lower carriage. Air is delivered to the pneumatic cylinder from a compressor at 5-6 atm and is fed into its lower cavity through a special valve by turning a handle.

Manual straightening is heavy and fatiguing labor. With such straightening of the disks (outer diameter of 1210 mm, thickness 6.5 mm) the average fluctuations in curvature are 3-5 mm. With automatic straightening (all other conditions being equal) these fluctuations are 1-3 mm.

It is necessary to avoid excessive and severe cold working since it can lead in time to fracture of the blades. The straightening plate should have comparatively high hardness and a sufficiently smooth surface.

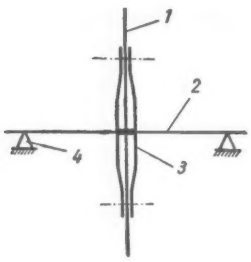


Fig. 3. Diagram of device for balancing blades; 1) Blade; 2) shaft; 3) face plates; 4) prism.

Balancing of the blades is accomplished on a device, the diagram of which is shown in Fig. 3. The blade, slipped on the shaft and clamped by face plates, is set on two prisms (knives). Then by hand-turning the blade we determine if it is unbalanced and mark the site for applying a load. After this, rivet holes are drilled at the site marked and these rivets hold down the extra weight on the cutting blade.

Balancing a blade directly fastened on the working shaft showed better results, since in this case unbalance was eliminated not only on the blade itself but also on the entire working shaft.

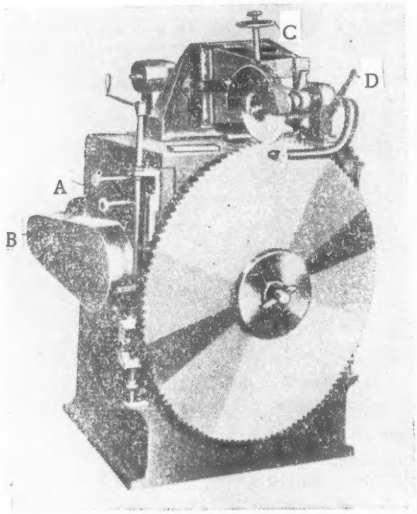


Fig. 4. Stand for sharpening blades.

Figure 4 shows a stand for sharpening blades. The blade at first is placed on the driven shaft and fastened by a thrust washer, springs and other pieces. The sharpening wheel should be raised above the lift lever P and not touch the saw blade. The blade must be arranged under the sharpening wheel so that the ends of its teeth are above the edge of the support (clamping) device that holds the upper part of the saw blade at a point lying 10-20 mm from the base of the tooth. After this the blade is fastened and the stand started. In order to regulate the stand relative to a suitable rate of feed, hand wheel A is turned to the left. By rotating it the magnitude of the feed rate of the delivery cog is regulated. The correct setting for the teeth of the blade corresponding to the sharpening wheel is achieved by turning hand wheel B. After this the sharpening wheel is lowered onto the blade and the sharpening operation started.

Hand wheel B is designed for raising or lowering the sharpener head. The hardness of the sharpening wheel should correspond to the quality of the blade material. A good surface quality on the sharpened teeth of a blade made of 50-steel is produced by using an abrasive with a grain size not less than 46 with a hardness of CM; the material is electrocorundum. Such an abrasive has a sufficiently high hardness.

The height of the teeth of the blade entering for sharpening is not identical. In practice this unevenness is also retained after sharpening. Such unevenness when hardening the blade teeth by electric contact heating leads to a disruption between the electrode and the tooth, the tip of which in this case is fused. This phenomenon explains to a considerable degree the cause for the lower durability of sharpened blades as compared with new blades. In order to eliminate somewhat the unevenness in the height of the blade teeth, after sharpening the sharpening wheel is applied to the blade until it touches the tips of the blade teeth, then by manually turning the blade the most-projecting tips of the teeth are cut off. This, for all practical purposes, improves the quality of hardening the blade teeth by means of electric contact heating.

The investigations which were carried out show that, in practice, after sharpening, the configuration of the teeth on various blades is different since the abrasive wheel gradually wears out. It is not always possible to note

this change during the sharpening process. Therefore in order to obtain a normal configuration of the teeth during sharpening it is desirable to use a master form.

The configuration of the teeth is also distorted after notching as a result of incorrect centering of the pack. The durability of the blades with such distorted teeth is considerably reduced since the tips of the teeth, having a considerable point when hardened by electric contact heating, are fused, and the blunted tips are insufficiently heated.

ON THE MAIN LINE OF THE SEVEN-YEAR PLAN

V. A. Popruga

Dzerzhinskii Metallurgical Plant
Translated from Metallurg, No.12,
pp. 34-35, 1960

Ten years ago, sailor Vasilii Fedorovich Pil'tyai, discharged from the Black Sea Fleet, returned to his native Dneprodzerzhinsk, the city of metallurgists. At that time, powerful blast furnaces were put into operation here one after the other, new steelmaking and rolling shops were constructed.

Vasilii worked at the plant and attended the evening metallurgical institute. The chief of the blast-furnace shop, A. N. Chechuro, in talking with Pil'tyai advised him to master the main specialties of the furnace, to "feel" blast-furnace work with his own hands in order to become a true engineer and true blast-furnace operator.

Vasilii Pil'tyai set out on the path from a general laborer to a competent engineer full of initiative.

In November 1958 the brigade of the No. 12 blast furnace of the Dzerzhinskii Plant gathered at an intershift meeting. A speech was given on the control figures of the Seven-Year Plan. At this meeting Pil'tyai stated that now, when our country is close to starting the construction of communism it is necessary to live and work in a different manner.

The shift method started. Each worker captiously looked over his own working place. He checked what was done and what was not done by the man he relieved. If it wasn't done, take away his points. All productive operations were evaluated in points. The more points, the more one earns.

V. F. Pil'tyai

There were cases when certain irresponsible workers did everything in order to receive more points, sometimes even to the detriment of the work. But such work does not refer to those people who build communism. Searches for another way began. And it was found. The brigade decided to live communistically, to fulfill the Seven-Year Plan in five years. This was the first collective of communist labor in the Ukraine.

Little time has passed since then. The brigade of Pil'tyai, having radically reconstructed its work and using efficient methods in the organization of labor and production, has given the country thousands of tons of metal in excess of the plan.

The point system of wages was abolished. Now they all work for a "common kettle." Wages are equally divided among the brigades. All workers started to fulfill carefully their obligations. Oxygen and natural gas for the first time in the country were successfully utilized in the furnace; the productivity of the unit was increased 10%. One hundred kilograms of coke are saved per heat of each ton of pig iron.

During the first year of the Seven-Year Plan the collective of No. 12 blast furnace delivered about 10,000 t of pig iron over the plan, saved about 40,000 t of coke. Number 12 blast furnace was awarded the title of Unit of Communist Labor. Here the cheapest pig iron in the Ukraine is produced.

Vasilii Fedorovich Pil'tyai said that the blast furnace operators of the USSR have outdistanced the blast furnace operators of the USA in the use of capacity but still lag behind it in the productivity of labor. During the Seven-Year Plan it is necessary to take a new verge: to outdistance the American blast furnace operators in this index also, for which it will be necessary to mechanize and automate labor-consuming processes, to improve production. The use of natural gas and oxygen, the use of shielded nozzles in order to increase the blast temperature, and the conversion to single-spout teeming of pig iron facilitates the work of the furnace attendants. The next task is conveyer delivery of the materials and the automation of the blast-furnace process. The main technological parameters on the basis of which a program can be compiled for the computers, the brain of automation, have already been sufficiently studied.

Vasilii Pil'tyai shares his impressions concerning the conference of Brigades of Communist Labor in Moscow.

Each blast-furnace operator of the communist unit is increasing his political and general educational level, his qualifications. Yurii Maidannik, for example, studies at the evening institute, Petr Lygun at the technical school. All members of V. F. Pil'tyai's brigade have mastered the specialty of crane operator; the foreman himself set the example for this. Now the furnace attendants run the crane; the crane operator, loading for 3-4 hr, is freed and goes to another section of work.

By invitation of the Zoya Kosmoden'yanskaya Pioneer Brigade V. Pil'tyai went with the brigade to the Pioneer camp. At the meeting all members of the brigade were made honorary Pioneers. V. Pil'tyai is in the foreground.

The blast-furnace operators actively participate in social life. Furnace attendant Petr Petrovich Lygun is a deputy of the Supreme Council of the USSR. Foreman V. F. Pil'tyai is a political agitator. Gas operator Yuri Maidannik is a group party organizer. Foreman Abramov is a member of the Presidium of the regional party committee. Here are propagandists, agitators, active worker-correspondents, participants of artistic activities.

Recently the Soviet Government awarded V. F. Pil'tyai the high rank of Hero of Socialist Labor. This award once again shows how highly the Communist Party and the Soviet Government value the labor of our metallurgists.

The blast-furnace operators of the Dzerzhinskii Plant participated in the active struggle for a pre-scheduled fulfillment of the Seven-Year Plan. On their account tens of thousands of pig iron are in excess of the plan. No small part of this belongs to the share of the collective of No. 12 furnace, where Vasilii Fedorovich Pil'tyai, communist, Hero of Communist Labor, works.

PRODUCTION OF PRE-FLUXED SINTER
QUALITY IMPROVEMENTS AND PROCESS INTENSIFICATION

A. I. Machkovskii. Chief Sinterman at the Dnepropetrovsk "Sovnarkhoz"

Translated from Metallurg, No.12,
pp. 35-37, 1960

In June 1960 the All-Union Inter-plant School for the sintering-plant personnel completed its work. The task of the school was to study, generalize on, and expound the experience with quality improvements and process intensification in the production of pre-fluxed sinter. The work of the school was conducted at the Magnitogorsk Metallurgical Combine and the following plants: Cherepovets, "Azovstal," Makeev, "Zaporozhstal," and Dzerzhinskii. Representatives from most of the sintering works of the USSR and also from leading scientific-research and design institutions participated in the work of the school.

Characteristics and Blending of Raw Materials

Concentrates and sintering ore that enter the sintering plants originate from many sources, fluctuate widely in chemical composition and particle size distribution and do not contain a consistent ratio of the various raw-material components. Thus the ore and concentrate fed to the "Azovstal" Plant come from 20 different mines and the iron content in them ranges from 42.2 to 61.0% (such fluctuations are ±5% at other plants).

The Cherepovets, "Azovstal" and Dzerzhinskii Works treat blast-furnace flue dust (local and brought in) in which the iron content fluctuates as follows: at the Cherepovets Works from 24.6 to 37.3%, and at the Dzerzhinskii from 34.9 to 45.0%. In addition pyritic calcines are included in the charge and the content of iron, silica, sulfur and other components in such calcines fluctuates through a wide range.

Large fluctuations in chemical composition of the sintering raw materials require meticulous blending.

At the Magnitogorsk Metallurgical Combine (MMC) blending starts at the mine and continues at the concentrating plants where the ore is crushed and blended in two stock piles from which it is then removed alternately. At the Cherepovets Works blending is achieved by batch distribution at the concentrate storage areas when forming the stock piles, the concentrate is removed in several streams from under the stock pile.

At the "Zaporozhstal" Works various classes of incoming ores are stored and blended separately. At the basis of the blending method is the multiple mixing of the ores by building the stock piles through multiple layers of the materials. This is achieved by continuously moving the unloading-crane clam shell while gradually opening its jaws.

At the Dzerzhinskii Works the ores of various classes and the blast-furnace flue dust are blended in a single stock pile. The ore undergoes a preliminary preparation in a trench at the ore yard and is thereafter spread onto the stock pile from which it is removed by two excavators. The stock pile is built in layers by means of clam shells for ore use. The excavators are shuttled between the portion which is being removed and the one being built. The system of having a single stock pile for a mixture of all ores and flue dust has proven out well in practice.

At the other plants blending is done by one of the above described methods.

In addition the ore and concentrate are blended when removed from the bins simultaneously by several table feeders. Notwithstanding these measures the fluctuation in chemical composition remains substantial. Thus

at the "Zaporozhstal" Works the ore which is fed to the feed hoppers has a fluctuation in the iron content of within ± 0.75% in only 60-75% of all samples. At the Makeev Works the blending quality is typified by fluctuations from the average Fe content as follows: within ± 0.75% and 34.5%, and within ± 1.0% in 47.7% of all samples.

Preparation of Fuel and Flux for Sintering

Coke fines consisting of a fraction 0-10 mm, coke breeze 25-40 mm, and anthracite dust are used as fuels in the sintering plants. The moisture content in the fuel ranges from 2 to 15%. There are no blending facilities for the fuel at any of the plants, a fact which impedes proper functioning of the sintering process.

Coke breeze of 25-40 mm in size must be crushed in two stages as is done at the MMC and the Krivoi Rog Metallurgical Works.

For crushing limestone, reversible hammer mills with controlled screening have been installed at virtually all sintering plants. Rod mills have not proven themselves, because of their low productivity, and are slowly being replaced by other equipment.

The content of the minus 3 mm fraction at the various plants is as follows, in %:

	In the fuel	In the fluxes
Cherepovets	93.7	90
MMC	94.5	98
"Zaporozhstal"	93–94	98
"Azovstal"	92.1	92.7
Dzerzhinskii	90.3	86.7
Makeev	87.6	95.0

Increasing Sintering-Machine Productivity

At the plants which were reviewed numerous measures were undertaken in order to intensify the sintering process and reduce the sintering-machine downtime. The most effective ones among these were the following:

1) At the "Zaporozhstal" Works it was the increasing of sinter basicity to 1.1, increasing the lime consumption to 37 kg/ton of sinter and the reconstruction of the exhaust fans.

2) At the Makeev Works it was the replacement of the seal plates on the hydraulic seals, installation of shutters such that now the multiclones may be repaired without shutting down the sintering machine, beading on edges of the hammer-mill discs, and the installation of two machines of the "OPR" type for roasting of limestone.

3) At the "Azovstal" Works it was an installation for mechanically cleaning the sintering-pallet grates, modification to the multiclone design, modifications to the sinter crusher, as well as replacement of the hammers and grates in the hammer mill.

4) At the "MMC" it was the installation of a breaker plate at the discharge end of the machine (thus obviating the need for a sinter crusher), installation of a cast iron collecting bin for returns, reinforcing of the skid chutes, swing feeders, and bins with manganese-steel plates and basalt plates.

5) At the Dzerzhinskii Works it was the installation of a vertical furnace for limestone calcination and the installation of self balancing screens for sorting of hot sinter.

6) At the Cherepovets Works it was the replacement of the three speed motor on the rotary pebble cooler with a direct current motor capable of a continuous speed regulation, and the replacement of assembled cooling plates in the gas-burner muffle with one-piece cast ones.

Sinter Quality

Data on sinter quality at the plants is given below in %. The fluctuations in chemical composition are rather large. This inadequacy may be explained by inadequate blending of raw materials and fuels, and at some plants, by the absence of metering facilities for sinter returns.

	Fe	SiO_2	CaO	FeO	Mn	MgO	Tumbling test	Reducibility
"Zaporozhstal"	46.05	14.63	15.67	11.16	1.26	–	21.3	36.3
Dzerzhinskii	49.91	13.41	13.41	9.20	0.48	–	25.3	56.0
Makeev	44.90	14.70	16.30	10.0	1.30	–	27.0	42.7
MMC, Sintering Plant No. 3	55.0	7.50	9.89	17.7	–	2.46	29.8	45.4
"Azovstal"	46.0	15.60	15.49	12.0	0.37	1.30	25.0	Not found
Cherepovets	49.6	13.3	15.6	16.3	–	–	–	–

Process Automation

It is regrettable that none of the plants had implemented a complex automation of the technological processes. At the various process stages there is automation in distribution and charging of the feed into the machine feed hoppers, feeding of the charge onto the pallets, maintaining the required height of sinter layer, control of sintering machine speed according to process performance, sampling the charge, and some other additional operations.

Technical and economic indices for the operation of the sintering plants in 1959 are shown in the table.

After familiarizing itself with the operation of the sintering plants the school noted that the existing practice of raw-material blending does not ensure obtaining sinter with a uniform chemical composition. This is because of the extremely irregular raw-material shipments to the plants and the insufficiently large reserves existing at the plants' stock piles. The fuel and limestone are not blended at all.

In order to improve the preparation of raw material and fuel for sintering, the school recommended the following: blend the iron ores and concentrates at the mines, ore storage areas and sintering plants; discontinue shipment of ore of greater than 8-10 mm particle size; blend the fuel at special depots equipped with crushing facilities for preliminary crushing. The school proposed to install screens before the crushers to screen off fines which need no comminution. It was also recommended that limestone be calcined on special machines which could be round, vertical of the OPR type, or strand type, and to conduct research work into calcining of limestone in fluidized beds. It was recommended to introduce lime into the process as closely as possible to the sintering machines.

Material Consumption and Sintering-Plant Operating Indices

Plants	Index					
	MMC, Sintering plant No. 3	Cherepovets	"Zaporozhstal"	Makeev	Dzerzhinskii	"Azovstal"
Consumption per 1 ton of sinter, kg:						
concentrate	983	802	–	5	–	32
sintered ore	–	–	776	758	782	689
manganese ore	–	–	41	50	6	–
blast-furnace flue dust	33	69	78	66	136	92
clinker and shavings	–	35	–	5	1	–
limestone	93	316	262	276	217	352
lime	–	–	14	14	10	24
pyrite clinker	–	14	25	53	23	12
dolomite	37	–	–	–	–	–
aniline slag	–	6	–	–	–	–
fuel	54,8		83	81	61	58
	75					
Production costs, rubles/ton	10,15	14,64	12,82	11,02	12.36	16,24
Downtime based on calendar time, %	3,41	9,7	5,64	5,5	3,78	4,55
Productivity* ton/hr per machine	88,25	90,0	104,9	82.7	85.8	95,0

* At the Cherepovets Works the machines have a sintering area of 75 m^2, at all other plants this area is 50 m^2.

The school found that the particle size of the fuel and limestone which is charged in for sintering must be reduced to below 2 mm. It was recommended that shaft mills for grinding limestone should be brought into production at the Cherepovets Works as soon as possible and their effectiveness should be investigated.

For the sintering-process intensification the school recommended increasing the lime content in the sintering charge to 4-5%; further increases in the lime content will improve sinter quality. It is necessary to crush the lime after its discharge from the calcining machines.

In order to increase the quantity of air passing through the charge layer to be sintered to 100 m^3/m^2min it was recommended that existing exhaust fans be rebuilt; specifically, by making their rotor blades wider and increasing the rotor diameter ("Zaporozhstal"). Also additional exhaust fans should be installed (Dzerzhinskii Works) and/or exhaust fans presently in operation replaced by larger ones (Krivoi Rog Works).

The school felt that it was necessary to recommend to the specialized plants the construction of exhaust fans with a 5000 m^3/min capacity for the existing sintering machines with an active area of 50 m^2.

In order to improve the mixing and nodulizing of the charge it was recommended to have two stages mixing and to increase the length of the mixing drums. It was also recommended to install direct-current motors on the mixing drums which would allow control of the r.p.m.; also to install table granulators before the drum mixers in order to give the charge a preliminary nodulizing.

The school noted that all plants are lagging in the field of improving charge-materials proportioning and recommended a speed-up in the introduction of automatic weighing and proportioning (Cherepovets, "Zaporozhstal", Alchevsk).

To improve the charge ignition on the machine, intensify the sintering process, and reduce consumption of solid fuel, it was recommended to lengthen the existing ignition muffles and to install additional muffles or deflectors (MMC, "Azovstal").

The school felt that work on sintering machines with an artificial bed, according to the experience of the MMC's No. 1 sintering plant, should be organized. It was also thought that implementation of two-stage sorting of sinter is attractive.

Transporting sinter after the coolers by means of rubber conveyor belts has not proven itself because the rubber belts fail in spite of the fact that sinter is sprayed with water. Moreover the spraying results in a sharp degradation of sinter quality. Accordingly it was recommended to discontinue spraying the sinter with water and to replace the rubber belts with metallic apron conveyors throughout the finished-sinter handling section (MMC, Cherepovets Works).

The school thought that it was mandatory to proportion the returns on an equal basis with other charge components, and to increase sinter basicity to the point where no raw limestone would be added to the blast furnace.

The school pointed out the necessity of production-scale experiments dealing with sintering of charges containing less fuel in the lower layers.

After reviewing the practice of the various plants in the area of improved working conditions, the school concluded that hydraulic removal of dusts is the most effective method for lowering the dust contamination. Plant floors should be flushed with water and charge materials should be sprinkled and moistened at all stages of handling, in bins and particularly in the sintering section.

The school recommended conditioning of air by means of water, in line with test work at the "Zaporozhstal" and Makeev Works.

The school noted that it is not permissible to use hot returns in the sinter charge. It was recommended that dust and vapors from the returns bins and from the table feeders be aspirated into the sintering machine collecting duct in line with the testwork at the Dzerzhinskii Works.

In order to settle out the dust it is necessary to wash out with lightly sprayed water the products of natural draft stacks and exhausters for the cooling drums and the table feeders which handle returns. In order to eliminate formation of a water-vapor mist in the conveyor galleries hot air should be introduced there.

The school pointed out the necessity to equip covered sinter-loading areas with an air aspiration system followed by washing of the dust laden air.

THE WORKERS ARE TAKING A MORE ACTIVE PART IN INDUSTRIAL DEVELOPMENT

M. S. Romanchenko. Instructor, Trade Union Regional Council

Translated from Metallurg, No.12,
p. 38, 1960

1055 men including 800 manual workers take active part in the Works Productivity Council and 18 Shop Productivity Councils at the Yuzhnotrubnoi (South Tube) Metallurgical Works. The personnel of the Works have elected to the Productivity Councils their most highly esteemed representatives, leaders in the Socialist competitions and innovators in production methods. For instance, among the elected members of the Productivity Council at the tube drawing shops are mill operators N. I. Grigor'ev who is a Merited Metallurgist of the U.S.S.R. and consistently exceeds the production quota by 10-12%, and operator G. V. Tsyganok who regularly exceeds the quota by 8-10% or more.

The staff and workers who are members of the Productivity Councils treat their duties with a sense of great responsibility. The members of the Productivity Councils analyze the economics of the Works thoroughly and consider all new suggestions carefully. As a rule the agenda of meetings of Councils contain problems which are closely related to the urgent needs of the Works and the prospects of future development of production. For instance at their meetings the Councils consider the problems of increasing the quality of production, increasing operating efficiency, extending the mechanization and automation of labor consuming processes, reducing the cost of production, increasing the educational level of the workers and other problems.

The work of the Permanent Productivity Councils has a positive effect on the functioning of the Works. By putting into practice 587 suggestions, out of the total 722 which were put forward in 1959, and by carrying out the recommendations of the Productivity Councils, the personnel of the Works completed the annual production plan for 1959 ahead of schedule and reduced the production cost considerably. The output increase, in comparison with 1958, constituted 16.4% for the over-all production and 14.2% for the steel-tube production.

The increase in the creative initiative of the tube mill workers can be judged by the fact that in the past year 2616 suggestions have been submitted to rationalize operations; in fact this is 600 more suggestions than in 1958. The introduction of accepted suggestions resulted in savings equivalent to approximately 8.5 million rubles and made it possible to make 69 workers free for other duties; 669 tons of carbon steel, 590 tons of alloy steel, 677 tons of fuel oil, 18 tons of bronze and copper and 848,000 kw hr of electric power have been saved.

In the first half of 1960 two meetings of the Works Productivity Council were held.

On March 3, 1960, the problem of the quality of tube production in connection with an increase in defective tubes and second grade tubes, was discussed. The Council heard the report of the Chief Engineer of the Works, S. I. Vasilenko, and the contribution of shop heads and heads of sections, foremen and workers who took part in the discussion. After a thorough consideration of the existing situation the Council proposed several concrete measures aimed at an improvement in the quality of tubes. After considering the recommendations of the Council, Works Director P. A. Trubchenko issued orders embodying the main resolutions passed by the Council.

By carrying out these resolutions and in particular by introducing daily reports by shop heads on the quality of tubes, on cases of deviation from established procedure and on other shortcomings, and as a result of the review of the technological instructions it was possible, as early as the second quarter of 1960, to increase the output of first grade tubes at the tube drawing shop by 0.7%, and to reduce the output of second grade tubes by 0.7 and of final rejects by 1.53% in comparison with the first quarter of the year.

In April 1960, a second meeting of the Productivity Council was held at which the report entitled "On the fulfillment of the task of reducing the cost of production in 1960" by the Head of the Planning Department of the Works, M. E. Podobedov, was discussed. This problem came under discussion because of the increase in production costs. The Works Director, his deputy, the Chief Accountant, the Chief Mechanic, the head of the Financial Department and other employees who took part in the discussion recommended a number of measures which would permit a reduction in production costs by 180,000 rubles below the planned target by May, 1961.

The Presidium of the Permanent Productivity Council held five meetings in the first half of 1960 and prepared a plan of activities for the next quarter, approved the teams set up for the preparation of problems for the next meeting, and considered all other matters submitted to the Presidium.

The Shop Councils have also worked well. At their 78 meetings they have considered several urgent problems and accepted 713 concrete suggestions of which 542 were utilized at the Works and made it possible to achieve considerable savings. For instance the suggestion of foreman D. E. Klinchuk regarding the mechanization of the cutting of grinding discs (a suggestion proposed during the discussion of the work of innovators and inventors at the casting shop) resulted in savings which amounted to 16.5 thousand rubles per annum, facilitated the work of the grinding-machine operator, improved the quality of the grinding operation and improved the safety. At the same shop, when safety and working conditions were discussed during a meeting of the Productivity Council, workers Zelenskii, Maslov, Zil'bert and some others suggested that the delivery of mandrels to the working places and to their thermal treatment should be mechanized. After the introduction of this suggestion, the efficiency of the operators increased by 25-30% and the working conditions improved.

The intensified, creative efforts of the personnel meant that the production quota for the first 6 months of 1960 was exceeded by 2.9%. Thousands of tons of tubes over and above the quota were produced.

The activities of the Permanent Productivity Councils are controlled and guided by the Party and Trade Union Organizations which at their meetings regularly consider the reports of the Presidiums of the Works Council and Shop Councils and of individual managers, and assist in bringing urgent problems for discussion at meetings. Common effort should be directed toward a further improvement in the work of the Productivity Councils, in particular with a view to organizing meetings of the Productivity Councils at the shops where they are not held regularly.

It is the duty of the Party and Trade Union Organizations to invite workers to participate in management even more extensively by making use of the inexhaustive creative energy of the workers in the fight for the completion of the 7-Year Plan ahead of schedule.

SUCCESSES AND SHORTCOMINGS IN THE WORK OF THE PRODUCTIVITY COUNCILS AT THE "SERP I MOLOT" WORKS

G. R. Bashkirov

Work Study Department "Serp i molot" Works
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pp. 39-40, 1960

The Permanent Productivity Councils at the "Serp i Molot" Works have been set up at all shops (except where less that 100 people are employed). On the whole, manual workers in all the main trades are represented on the Councils (75% of the total number of Council members).

The Works Productivity Council consists of 152 men, elected at meetings of Shop or Shift Councils. There are steel melters, rolling-mill operators, steel casters, machine operators, workers from all shops, as well as tech-

nical personnel and representatives of the Administration. The Director of the Works, the Secretary of the Party Committee and the Deputy Chairman of the Trade Union Committee are also members of the Council. The Presidium of the Council consists of 11 men; the head of the Technical Control Department is the chairman of the Council.

The work of the Council is carried out in accordance with the quarterly plans which contain agenda for the meetings of the Council and Presidium, the data and time of meetings, the names of those responsible for arranging the meeting and the list of measures which have to be carried out by the members of the Presidium and of the Council. Problems which require the consideration of the Council are prompted by the actual needs of industrial life. Thus, for instance, the Council has discussed the problems of improving the organization of work and the establishment of production standards, the saving of materials and equipment, the problem of housing and some other questions.

At present an intensive fight to reduce the cost of production is under way. The next stage in this fight was the subject of a meeting at which the head of the Planning Department M. M. Samar'yanov presented a report and gave a thorough analysis of the factors which influence the cost of production and presented a detailed account of ways of reducing production costs. Several contributors made their suggestions during the discussion of the paper.

Steel melter M. D. Tuzov suggested to develop concrete measures to reduce the cost of production in each shop, plant and section; to tell the workers about the factors which influence the cost of production and to provide electric furnaces with scrap, sorted according to grades.

Rolling mill operator G. T. Esipov made a suggestion regarding the reception and weighing of the billets supplied to the section mills. Electrician I. S. Kunitsyn considered that it was essential to establish definite days for equipment repairs, and also a definite day-off for the sheet-rolling mill and for Mills 250 and 300 of the section shop in order to make it possible to switch off the transformers once a week at the power sub-station and thus achieve a substantial saving in electric power consumption.

Other contributors also made several valuable suggestions. However, on the recommendation of the Productivity Council, with the object of finding new ways of solving this important problem of production-cost reduction, active trade unionists and administrative personnel of the Works organized and convened an Economic Conference at the Palace of Culture to which the representatives of the S. Ordzhonikidze Moscow Engineering and Economic Institute were invited. The Conference outlined a number of important measures which, when realized, will undoubtedly result in a substantial reduction in production costs.

At present the main object of the Productivity Council of our Works is to solve the problems connected with the introduction of new techniques.

Among the best existing Shop Productivity Councils are the Council of the Wire Shop, that of the New Project Department, that of the Power Supply Department and that of one of the Open Hearth Shops. Heads of these departments and shops, A. P. Khrenov, D. A. Yushin and N. I. Bogolyubskii bring forward the problems for discussion at meetings of the Council, present papers at the meetings, consider new suggestions, appoint people to be responsible for carrying out the suggestions in practice and determine schedules for putting the approved suggestions into practice.

The chairmen of the Trade Union Shop Committees, E. S. Koptev, A. V. Taruntaev and V. A. Lukin hear the reports by the Chairmen of the Productivity Councils at the meetings of the Trade Union Shop Committees and explain important industrial problems. Members of the Productivity Councils explain the significance of the resolutions to the workers and administrative personnel and take an active part in putting the resolutions into practice.

A. I. Sverzhin, the Chairman of the Productivity Council of the wire shop pays a great deal of attention to the information about the work of the Council; there is a special notice board, where the schedules of the work of the Council, suggestions approved by the Council, and corresponding orders issued by the head of the shop, are displayed. The Council reacts quickly to any new development at the shop. Thus, for instance, at the beginning of the current year the amount of the defective product increased and large losses of metal occurred in all sections owing to failures in maintaining the right operating conditions and procedures; the heads of the shifts and the foremen have faltered in the fight to improve the quality of production. The problem of intensifying this fight was put on the agenda of the Council which recommended several valuable practical measures including the

recommendation to register the quantity of the steel accepted for production and the permissible allowances for losses in the documents related to the steel received for processing. The manufacturers were recommended to keep the record of the output of every shift according to the production documents; in the silver steel section, each shift should be alloted the output quota and the metal for machining and polishing should be weighed and its weight recorded before it is issued to the worker; for a better heating of the metal the wire coils should weigh not more than 50 kg; welding equipment should be set up at the patenting furnaces.

The Administration of the Works considered these suggestions and took appropriate decisions. As a result the output of acceptable product very soon increased and the amount of the rejects was reduced.

The Chairman of the Council of the New Project Department A. K. Zolotukhin keeps an accurate record of all suggestions in a special book in a tabulated form (date of suggestion, description, name of author, scheduled date of completion, who is responsible for completion). As well as hearing from the members of the Presidium who work at given sections he himself follows the process of how the suggestion is being put into practice. At the meetings, before a problem is discussed, a representative of the Administration reports on the progress in carrying out a previous decision. The Council has a tentative plan for the whole year and this assists members of the Council in preparing the necessary problems on time.

The Council has already considered a number of important problems. It asked the Administration of the Works to improve discipline – to introduce a card index for tools and to issue tools before the beginning of each shift. The quality of the erection operation and the problem of savings and the careful use of construction materials were also considered. In accordance with the decisions of the Council, the bricks are now delivered in containers and are carefully stacked, a commission for the inspection and acceptance of all types of finishing operations has been set up and storage facilities for building materials are being prepared. As a result of these measures the quality of the buildings has increased and the discipline of the builders and the operating efficiency have improved.

The Productivity Council of the power supply shop attaches great importance to the supply of energy to the Works. At its meetings, the Council considers measures aimed at preventing energy losses in all forms at the Works. Suggestions were put forward to reduce oxygen losses during emptying and filling the gasifiers, to heat the water in the economizers to 80-90°C, to check regularly for any leakage of compressed air, steam, water or oxygen at the shops and to take steps to eliminate any leakage immediately. At present a plant for collecting oxygen is being erected. Putting these measures into practice will assist in the improvement of energy consumption at the Works. The Council also considers it necessary to take steps to prepare for operations during spring and summer as well as winter and autumn conditions.

In spite of the successes in the work of the Shop Councils not everything is so well organized. At several shops the Productivity Councils are working inefficiently and hardly influence the work at the shop or at the Works. For instance, the Productivity Council of the scrap preparation and charge preparation shop met only once for the first six months of this year to discuss the report of the head of the equipment shop, A. I. Vinokurov, on his visit to other Soviet Works. No decisions or suggestions in connection with this subject were taken. The Council at one of the open-hearth shops held no meetings for five months. The Council at the repair and erection shop is completely inactive.

What is the reason for such poor work of these Productivity Councils? The head of the scrap and charge preparation shop, V. G. Grigor'ev, does not pay enough attention to the activities of the Council and does not bring any problems to the attention of the Council. At one of the open-hearth shops and in the repair and erection shop, the elections of the govening bodies of the Council were not treated seriously, and people who were not suitable for these posts were elected chairmen. Some shops elected workers who were not interested in these activities to the Council.

Some representatives of the administration do not take enough notice of the decisions of the Councils. For instance, the Head of the section rolling mill, V. A. Ermolaev, has not carried out the suggestion of the workers regarding the setting up of a workshop for the repair of roller guide for section mills, although he knows full well that the use of these guides would make it possible to increase the operating efficiency immediately and improve the quality of the product substantially.

The question of establishing one date for all shops to hold monthly meetings of the Productivity Councils has not been yet settled. Therefore, the meetings of Shop Councils frequently coincide with some other general

event at the Works and hence the meetings are either not well attended or not held at all. For instance on the day of the meeting of the Productivity Council at the rolling shop, an innovators' meeting took place.

The Trade Union Works Committee supervises the activities of the Productivity Councils. The chairmen of the Trade Union Shop Committees and the representatives of the Administration report regularly on the work of the Shop Productivity Councils at the meetings of the Trade Union Works Committee. The Committee organized courses on the procedures and information exchange of the Productivity Councils for the chairmen of the Trade Union Shop Committees and the Chairmen of the Productivity Councils. It is, however, obvious that there is still need for a great effort on the part of the Party and Trade Union Organizations and the Administration of the Works to extend these activities and to secure a leading position for Permanent Productivity Councils in order to solve the problem of completing the 7-Year Plan ahead of schedule.

NEW BOOKS

A Concise Handbook for Metallurgists. Editor V. P. Adrianova, Moscow, Metallurgizdat, 1960. 370 pages, Price 12 rubles.
Translated from Metallurg, No.12, p. 40, 1960

Metallurgists now have a book for which there has been a long felt need. The book which has been written by a group of specialists in the iron and steel industry comprises all branches of the metallurgical industry.

After a general chapter which contains a short account of the development of the iron and steel industry in the U.S.S.R., frequently used technical data and equations required in every day work as well as conversion tables of English and American weights and measures to the metric system, there is a section containing data on the properties of materials used in the iron and steel industry and the characteristics of fuels and refractories.

The chapter "Pig Iron Production" contains basic statistical and technical data on blast-furnace production such as: the characteristics of ores, sinter, fluxes and coke in the U.S.S.R., and information on the calculations relating to pig-iron metallurgy including the basic parameters of the blast furnaces. At the end of this chapter, information on the production of pig iron, steel and rolled products in the U.S.S.R. and on the output of ferrous metals per head of population in the large capitalist countries is presented.

In the next chapter, "Steel Production," the reader will find the main parameters of open-hearth, electric-steel furnaces and converters. There is also a description of new steelmaking processes, such as Kal-Do, rotary and others, a description of the equipment of steelmaking shops, standard consumption rates for materials during the production of steel and ferroalloys. Information on the steel production of the U.S.S.R. and the main capitalist countries is given at the end of the chapter.

The chapter "Rolled Steel Production" contains characteristics of rolling mills, and data on steel consumption, and on the consumption of electricity, fuel, water and mill rolls per 1 ton of finished rolled-steel product. There are also basic equations for the calculations used in steel rolling, the chemical composition and mechanical properties of mill rolls and statistical data on rolled steel production in the U.S.S.R. and some capitalist countries.

The chapter "Tube Production" contains a description of methods of tube production, tolerances and the theoretical weight of steel tubes. There are also statistical data on the production of tubes in capitalist countries.

The chapter "Automatic Control" in which the elementary theory of control is discussed and various types of controllers and instruments employed at iron and steel works in our country are described is of great interest. Systems of automatic control for the main units in the iron and steel industry, i.e., blast furnaces, open-hearth furnaces and reheating furnaces as well as rolling mills are described at the end of the chapter.

The handbook also includes chapters on "The Economic effect of adopting some new methods in the iron and steel industry" and "The classification of steels and the designation of grades." Technical specifications for ferrous metals are quoted at the end of the handbook.

A large number of copies of "A Concise Handbook for Metallurgists" has been printed. This handbook will be very useful for our metallurgists.

A.G.

DEVELOPMENTS IN THE OPERATION OF AMERICAN BLAST FURNACES

N. I. Krasavtsev, Winner of the Lenin Prize

Stalino Branch of the Ukrainian Institute of Metals

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pp. 41-43, 1960

In the middle of the last century blast furnaces in Western Europe were operated at a very low throughput (Table 1).

Up to the seventies of the last century American blast furnaces did not differ much from European blast furnaces as regards throughput. However, beginning in the seventies American metallurgists gradually increased the rate of the blast-furnace process and in the next twenty years they achieved considerable successes (Table 2).

From 1871 to 1889 the maximum output of the blast furnace increased from 58 to 347 tons per 24 hr, the ratio of the blast furnace working volume to the daily output went down from 5.6 to 1.49, and the throughput rate increased from 0.239 to 0.548 t/m^3. The successes of the American furnace operators made a great impression on European metallurgists.

L. Bell, during the discussion of Gayley's paper, said that he had previously thought it impossible that a furnace could yield 2500 tons of pig iron per week (359 tons per 24 hr) and at the same time use so little coke—only 840 kg per ton of pig iron. In his view, the speed of the gases in Gayley's furnace was excessive since gas evolution in this furnace was four times as great as in blast furnaces in Middlesborough (England). Such a rapid rate of the blast furnace process could lead to large heat losses. However, this was not found in practice.

Bell could not find an explanation of this fact which he considered extraordinary. He put forward the assumption that the low temperature of the blast-furnaces gases in Gayley's furnace resulted from the high specific heat of American iron ore.

The following fact in the history of the development of the blast furnace operation in America at the end of the last century should be mentioned. After a successful intensified operation of blast furnace A at the Edgar Thomson Works, the opinion that it was advantageous to increase the blast rate spread among American blast-furnace operators. With the increased blast rate, however, an increase in the specific consumption of coke frequently took place. In 1885, Engineer Potter took a stand against the excessive blast rate and suggested that a higher efficiency could be achieved by reducing the coke consumption. Gayley started his work at the Edgar Thomson Works by reducing the blast rates and this resulted in a lower coke consumption. He based his opinion on the fact that during the first campaign of the furnace the blast rate was 680 m^3/min and the coke consumption was 1161 kg/ton, whereas when the blast rate during the third campaign was increased to 880 m^3/min the coke consumption increased to 1272 kg/ton. Gayley reduced the blast rate to 790 m^3/min and tried to reduce it even further, but was prevented by the uneven running of the blast furnace.

At furnace D (537 m^3 volume), soon after it was blown in (Sept. 1885), air was charged at the rate of 725 m^3/min, and two months later the rate was reduced to 625 m^3/min. In November, the coke consumption constituted 1070 kg/ton; in December, with a lower rate of blast, a higher quantity of pig iron was produced on account of the reduction in consumption to 870 kg/ton. At the end of the campaign the blast rate was increased to 765 m^3/min; this was explained by an uneven running of the furnace at low blast rates.

Thus, as early as the last century, the American blast-furnace operators discovered the fact that an increase in the rate of the blast-furnace process results in an increase in coke consumption, and a lowering in the rate of

TABLE 1. Operating Statistics of European Blast Furnaces (according to data by Valerius)

Furnace	When blown in	Blast furnace volume, m³	Throughput, ton		Ratio of blast-furnace volume to daily output		Process rate ton/m³		Coke consumption, kg/ton pig iron		Blast rate				Remarks
			Maximum	Minimum	best	worst	Maximum	Minimum	Maximum	Minimum	m³/min	m³/min/m³ of blast furnace volume	Pressure atm	temperature °C	
Furnace (Isabella)	1876	425	76	no data available	5,6	no data available	0,239	no data available	—		no data available		0,28—0,42	540—590	
Furnace "Luise" (Carnegie Co.)	1877	436	119	same	4,3	same	0,286	same	1279		450	1,03	0,35	490	In 60% Fe ore
Edgar Thomson Works, Furnace A.	1880	181	90	53,5	2,01	3,39	0,51	0,342	1194	861	425	2,34	0,44	565	Maximum output 9.7 tons; ratio of blast furnace volume to daily output = 1.86. Ore charge contained 55% Fe
Edgar Thomson Works, Furnace B, first campaign	1880	506	154,5	92	3,29	5,52	0,373	0,205	1255	1046	850	1,68	no data available	590	55% Fe in ore, 2% Si in pig iron
Edgar Thomson Works, Furnace C	1882	608	207	180	2,93	3,36	0,385	0,346	1168	1066	765	1,26	0,63—0,7	540	
Edgar Thomson Works, Furnace B, third campaign	1885	472	204	173	2,31	2,73	0,478	0,42	1283	1073	880—790	1,87—1,67	0,6	650	Gayley became the Manager of the Works in October, 1885
Edgar Thomson Works, Furnace D	1885	537	214	207	2,51	2,59	0,426	0,364	1070	940	623	1,15	no data available		Soon after the blowing in, the blast rate was 765 m³/min. Two months later it was reduced to 625 3m³ and was maintained at 711° C. By the end of the year the blast rate was 765 m³/min.
Edgar Thomson Works, Furnace B, fourth campaign	1887	488	240	190	2,04	2,55	0,49	0,369	1049	890	680—765	1,4—1,57	0,56	650	Maximum output 260 tons/24 hrs.
Edgar Thomson Works, Furnace E	1886	560	275	220	2,04	2,52	0,528	0,384	1094	864	765	1,37	0,66—0,67	650	
Edgar Thomson Works, Furnace F.	1889	515	347	214	1,49	2,3	0,548	0,475	1094	775	708	1,38	0,67	600	The blast-furnace waste gas contained 11.7% CO_2 and 27.8% CO. Slag Production was 540 kg/ton; slag contained 33% SiO_2 and 13% Al_2O_3.

the blast-furnace process results in a reduction in coke consumption. This was observed at the very low (by present day standards) blast-furnace process rate of 0.35-0.47 ton/m^3/24 hr (maximum 0.6 ton/m^3/24 hr). The blast rate per 1 cubic meter of the blast-furnace working volume was 1.4-1.6 m^3/min.

American metallurgists explained the increase in coke consumption accompanying the increase in the blast-furnace process rate by the excessive rate of descent of the stock which prevented adequate indirect reduction.

That this explanation was incorrect has been proved by the operating experience on modern blast furnaces in which the process rate is more than twice that of the old American furnaces of Gayley's period, while the coke consumption is lower.

TABLE 1

Operating Statistics of European Blast Furnaces (according to data by Valerius)

Country	Blast furnace volume, m^3	Daily output, tons	Ratio of blast furnace volume to daily output, m^3/ton 24 hrs.	Residence time of charge in furnace, hrs.	Remarks
France	15 30	2,5—3,0 5—6	6—5	14—16	Ratio of blast furnace to daily output in France was frequently as high as 12.5
England	75 200 250	7,5 20 20	10 10 12,5	36 30—36 40—45	
Belgium	100 79,5	15 10	6,5 7,95	Up to 4 days	Coke consumption per 1 ton of pig iron = 1.4-1.5 tons; rate of blast furnace process 0.189-0.21 ton/m^3

It is obvious that the lack of time could not be the reason for the inadequate indirect reduction during the high-rate blast-furnace process since in the days of Gayley the blast-furnace operation involved a resi - dence time of the materials in the furnace almost twice as long as at present. The increased coke consumption observed during the operation at higher blast rates was apparently caused by other factors.

Present day metallurgists should bear this fact in mind in order to avoid the error of assuming that the increase in coke consumption when the blast furnace rate is increased above 1.0 ton/m^3/24 hr is caused by a lower indirect reduction due to inadequate time.

Since in Gayley's days the blast-furnace process rate was not determined by the lack of time for indirect reduction, therefore it cannot be the determining factor now. The figures which relate to the development of the blast-furnace operation in the U. S. A. and which we have quoted here show once more that it is wrong to assume that we have now reached the maximum blast-furnace process rate.

An improvement in the preparation of raw materials for the blast-furnace process, the application of new methods and the improvement in the method of operation of the blast furnace will make it possible to increase the rate of the blast furnace process considerably without increasing the coke consumption.

ROASTING LIMESTONE IN ROTARY FURNACES

L. E. Lukich, V. A. Brandt, I. D. Chigrai

and I. N. Varnavskii

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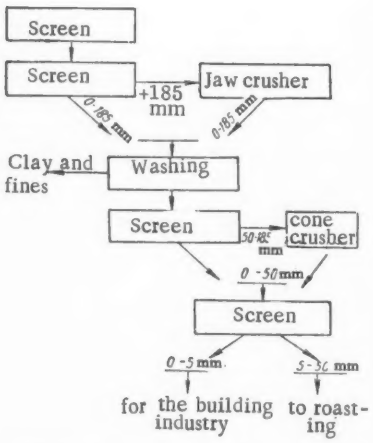
Near Liege in Belgium there is a plant belonging to Dumont Vater for roasting limestone. The Plant is situated near a limestone quarry where the limestone is pit mined. The limestone is transported by 20-ton self-unloading trucks to a jaw crusher from which it is delivered to a screen. The +185 mm fraction is crushed further in another jaw crusher and the 0-185 mm fraction is washed and afterwards enters a screen where the 0-50 mm fraction is separated. 50-185 mm limestone fraction is ground in a cone-crusher after which the 0-50 mm fraction is combined with the tails from the proceeding screen and enters the last screen where it is separated into two fractions: 0-5 and 5-50 mm. The 0-5 mm fraction is used in the building industry and the 5-50 mm fraction is delivered for roasting in rotary furnaces (96-99% $CaCO_3$ content).

The flow diagram of the preparation of limestone for roasting is shown in the diagram.



The diagram of the preparation of lime for roasting in rotary furnaces

There are two silos, each of 1500 ton capacity, for storing the limestone between the crushing-and-screening plant and the furnaces.

The limestone is roasted in two tubular rotary furnaces, each 135 m long, set at an angle; the level difference between the front end and the tail end of the furnace is 3 m. The internal diameter is 2.95 m and is uniform over the whole length of the furnace. The furnace is divided into three zones with regard to the thickness of the lining:

1) 20 m long section; the thickness of the lining is 250 mm, the lining material is magnesite bricks, the temperature in this zone is 1600°C.

2) 40 m long section; the thickness of the lining is 200 mm, firebrick lining material (40% aluminum silicate), the average temperature in the zone is 850°C.

3) 75 m long section; the thickness of the lining is 175 mm, firebrick lining (28% of aluminum silicate), the mean temperature in the zone is 850°C.

The temperature of the waste gases downstream of the stack damper is 300-350°C. The speed of rotation of the furnace is 60-70 revolutions per hour.

It was intended to fire the furnaces with pulverized coal. This fuel however affected the lining of the furnace. At present, one furnace is fired with oil, and the other with oil with an addition of pulverized coal (to ensure a longer flame). The fuel oil consumption is 3000 liters per hour. The length of flame is 5.5-6 m.

The fuel is preheated by steam to 130-135°C, and the air to 150-160°C. The sulfur content of the oil is 3.25%. The output of each furnace is 27 tons of lime per hour.

The roasted lime is transported to a screen where the 0-8 mm fraction is screened off and transported to an intermediate storage for dispatch to the sinter plant. The 8-50 mm fraction is transported by a conveyer to the silos.

It should be mentioned that the lime is again screened before it is sent to the consumer. In the Thomas Converter Shop the lime is again screened when it is delivered from the receiving bins to the feeders above the converters. The screening of fines after each unloading ensures as complete a utilization of the lime as possible (the fines are used in the building industry). This method should also be adopted at our works.

Finished lime contains not more than 3% SiO_2, 0.02-0.03% S and about 1% MgO. Incompletely burnt material constituted 1-2%.

In the opinion of the management of the Dumont Vater Co. the rotary limestone-roasting, oil-fired or gas-fired, furnaces are the most efficient units for producing good quality lime. It is very difficult to attain a good quality lime in shaft furnaces, especially gas fired ones.

New lime roasting plants which are being built in Belgium are provided with rotary-furnaces only.

New Books

The Utilization of Brown Chromium Ore from the Serov Deposits.
Sverdlovsk, 1959, 160 pages.
Translated from Metallurg, No.12,
inside back cover, 1960

This collection contains the Proceedings of the Coordination Conference, held in February, 1958, in Serov, which discussed the results of research work on brown chromium iron ore of the Serov Deposits and outlined future technological and geological investigations. At this Conference reports were presented on the work carried out by the Laboratories of the Institute of Metallurgy of the Urals Branch of the Academy of Sciences, USSR, the Laboratory of the Uralmechanobr, and the Laboratory of the Urals Geological Department.

In the introductory paper entitled "On the problem of the utilization of brown chromium ore," I. D. Bardin stressed the importance which the Serov Deposits are acquiring in connection with the increase in fuel production and the shortage of iron ore in the Urals; the author approved the scheme (which was discussed at the Conference) of integrated utilization of the main bulk of brown chromium ores—the pisolitic ores. He stressed the necessity for expanding experimental work on the extraction and processing of ocherous laterite ores with a high cobalt and nickel content; he recommended the application of hydrometallurgical methods for processing the ore, and also pointed out the necessity for expanding geological prospecting with a view to determining the industrial supplies of brown chromium ores available in the near future.

The paper by B. P. Revebtsov and E. M. Barinov entitled "The present position and ways of solving the problem of the utilization of brown chromium ore of the Serov Deposits" contained a short history of the discovery and exploration of the Serov Deposits; it also gave the chemical composition of the main ore types and a tentative scheme for the utilization of the ore.

The scheme envisages a substantial beneficiation of the ore, the production of combined iron chromium sinter containing 56-58% Fe and the processing of the sinter in the blast furnace to obtain chromium-nickel pig-iron and blast-furnace slag with a high aluminum content. Pig iron, containing up to 4.0% chromium and up to 0.10% phosphorus, can be processed in a converter to carbon iron semiproduct for subsequent processing in the open-hearth furnace or for the direct production of low-alloy steel. The paper showed the advantages of this pig-iron over the pig-iron obtained from Orsk-Khalilovo ores which contains almost five times as much phosphorus.

Converter slag containing 30-40% chromium oxide can be used for the production of ferroalloys, potassium bichromate and other potassium compounds. High-alumina blast-furnace slags are suitable for the extraction of aluminum and for the production of cement.

The paper by Geologists Kozhevnikov, E. I. Kozubovskii and L. I. Kononova, entitled "The present state of explorations of the Serov Deposits of chromium iron ores and their future prospects" was devoted to the history of exploration work, a detailed geological description of the deposits, and the minerological and chemical characteristics of the pisolitic and the ocherous laterite ores.

Methods of preparing the brown chromium ores were described in three papers: "The beneficiation of chromium-containing brown iron ore from the Serov region" by G. Ya. Miller, "Specific features of the method of beneficiation of heavy brown chromium iron ores from the Auerbach deposits," by A. I. Izmodenov, G. T. Kozhevnikova, E. S. Sokolova, I. S. Sverdel', S. E. Friedman, S. N. Buchel'nikov, B. M. Smirnov and T. A. Firenkrants, and "The sintering of brown chromium concentrates and the use of the sinter for the production of pig-iron" by S. V. Shavrin, V. P. Revebtsov, A. V. Chentsov.and V. Sapozhnikova.

In his paper V. Ya. Miller reported the results of the experiments on the beneficiation of the Auerbach brown iron ores. These experiments were made in 1930, 1932, 1933 and 1957. As a result of the studies carried out, it was established that it was impossible to remove the chromium from the ore by methods of mechanical beneficiation. It was also preliminarily established that the most effective method for the beneficiation of these ores is washing and dry and wet magnetic separation in weak and strong fields. With these methods it is possible to obtain a concentrate containing 51-53% iron, the efficiency of extraction being 70-76%. The same conclusion was reached by the authors of the second paper. With the proposed processing scheme, one can obtain a concentrate containing 52.6% iron from ores containing 36% iron, the efficiency of extraction being 65% and the yield of concentrate 44.5%.

The content of chromium in the concentrate will be not less than 2.5% and that of phosphorus not more than 0.04%. The ratio of silicon to aluminum in the concentrate is 0.9 and requires the blast-furnace process to be carried out with alumina slags.

A series of experiments on processing chromium pig iron, and investigations ofsteel semiproducts, low-alloy steel and high-chromium slags as well as the results of processing the latter were described in three papers: "The results of preliminary investigations into the technology of blowing pig-iron obtained from brown chromium ores and producing a semi-product, steel and high chromium slag," by V. P. Revebtsov and B. A. Abramov, "The study of the structure and properties of high chromium slags," by B. A. Abramov, V. P. Revebtsov and P. V. Sapozhnikova, and "The use of high-chromium conversion slags for the production of chromium compounds" by G. N. Bogachev. The investigations provided a basis for a scheme for the utilization of brown chromium ore as described in the paper by V. P. Revebtsov and E. M. Barinov.

In his paper "The future prospects for utilizing Pechora coals in the Urals" N. M. Kokosov favored starting immediately the transportation of Pechora coals to the Urals by the existing railroads, and starting preparatory work on the erection of beneficiation plants in the Urals for the Pechora coals.

The last paper in the collection was devoted to the ocherous ores in the Serov Deposits.

During the discussion, contributors pointed out the fact that none of the authors mentioned the possibility of the direct reduction of brown chromium ore and the production of iron in this way. At the same time this method may make it possible to separate iron from chromium and eliminate the necessity of the operation with alumina slags. It was pointed out that brown chromium ore from the Serov Deposits cannot be considered as entirely similar to that from the Auerbach Deposits. The suggestions made by authors regarding the intensification of the exploration work on the Serov Deposits and the transportation of Pechora coals to the Urals were supported and amplified by the reminder that it is essential not to neglect the prospecting of magnetic iron ore deposits.

The Conference approved the beneficiation scheme and processing method of brown chromium ore developed by the Institute of Metallurgy UFAN and the Uralmekhanobr and it proposed that these schemes should be tested on a commercial scale. It was also decided to ask scientific establishments to carry out experiments on the production of iron from brown chromium ore. The Conference decided that it was necessary to carry out investigations on laterite ores, to intensify the geological prospecting of the Serov Deposits and to start preparatory work on the utilization of low-phosphorus Pechora coal at the Serov Works.

I. SH.

MISSING PAGES ARE INDEX PAGES
WHICH HAVE BEEN PHOTOGRAPHED
AT THE BEGINNING OF THE VOLUME(S)

SIGNIFICANCE OF ABBREVIATIONS MOST FREQUENTLY ENCOUNTERED IN SOVIET PERIODICALS

FIAN	Phys. Inst. Acad. Sci. USSR.
GDI	Water Power Inst.
GITI	State Sci.-Tech. Press
GITTL	State Tech. and Theor. Lit. Press
GONTI	State United Sci.-Tech. Press
Gosénergoizdat	State Power Engr. Press
Goskhimizdat	State Chem. Press
GOST	All-Union State Standard
GTTI	State Tech. and Theor. Lit. Press
IL	Foreign Lit. Press
ISN (Izd. Sov. Nauk)	Soviet Science Press
Izd. AN SSSR	Acad. Sci. USSR Press
Izd. MGU	Moscow State Univ. Press
LÉIIZhT	Leningrad Power Inst. of Railroad Engineering
LÉT	Leningrad Elec. Engr. School
LÉTI	Leningrad Electrotechnical Inst.
LÉTIIZhT	Leningrad Electrical Engineering Research Inst. of Railroad Engr.
Mashgiz	State Sci.-Tech. Press for Machine Construction Lit.
MÉP	Ministry of Electrotechnical Industry
MÉS	Ministry of Electrical Power Plants
MÉSÉP	Ministry of Electrical Power Plants and the Electrical Industry
MGU	Moscow State Univ.
MKhTi	Moscow Inst. Chem. Tech.
MOPI	Moscow Regional Pedagogical Inst.
MSP	Ministry of Industrial Construction
NIIZVUKSZAPIOI	Scientific Research Inst. of Sound Recording
NIKFI	Sci. Inst. of Modern Motion Picture Photography
ONTI	United Sci.-Tech. Press
OTI	Division of Technical Information
OTN	Div. Tech. Sci.
Stroiizdat	Construction Press
TOÉ	Association of Power Engineers
TsKTI	Central Research Inst. for Boilers and Turbines
TsNIÉL	Central Scientific Research Elec. Engr. Lab.
TsNIÉL-MÉS	Central Scientific Research Elec. Engr. Lab.-Ministry of Electric Power Plants
TsVTI	Central Office of Economic Information
UF	Ural Branch
VIÉSKh	All-Union Inst. of Rural Elec. Power Stations
VNIIM	All-Union Scientific Research Inst. of Meteorology
VNIIZhDT	All-Union Scientific Research Inst. of Railroad Engineering
VTI	All-Union Thermotech. Inst.
VZÉI	All-Union Power Correspondence Inst.

Note: Abbreviations not on this list and not explained in the translation have been transliterated, no further information about their significance being available to us - Publisher.